PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

JULY, 1939

A. PRESCOTT FOLWELL, Editor — VOL. 70. NO. 7 — W. A. HARDENBERGH, Asso. Editor

Contents

TIMEWASTERS

Cats and Diamonds:

The cat crop mentioned in the June issue wasn't so great. Since the room was octagonal, and there was a cat in each corner, each cat had 7 cats in front of it. Inasmuch as each cat was sitting down (on its tail), there were exactly 8 cats. When it came to eating rats, the same original 6 cats could eat 100 rats in 100 minutes, providing their capacity was equal to it. Mr. Blunk says the rats should be small or the cats very large; preferably both. Check and double check by Mr. Wheeler.

The diamond situation was a good one; however, in an unlucky moment, we have mislaid Mr. Bevan's scholarly solution of this problem. Mr. Vinson tells us that it was necessary to whittle off about 23/32 of the round diamond, leaving a little less than 0.6 carat. We'll check this later.

Roll Up Your Sleeves

One from Frank Daniels, which is not too clear. There are two buoys in a river, just one mile apart. A man starts at the upper buoy to row upstream, but just as he starts his hat blows off and begins to float down stream with the current. He continues to row upstream for 20 minutes, when he decides that he needs that hat after all, and starts down after it. He catches the hat at the downstream buoy. How fast did he row and how fast was the current?

Given 21 casks; 7 are full; 7 are half-full; 7 are empty. Divide these among 3 people, without transferring liquid from cask to cask, so that each person has an equal quantity of liquid and an equal number of casks. Cleveland Engrg. Soc.

W. A. H.

SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

FOUNDED IN 1896

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 326 Bulkley Bldg., Cleveland, Ohio

CHEVROLET'S TRUCK LINE is a Fleet in Itself

Choose from its 47 models, on nine wheelbases, the truck best suited to your needs

The wide margin by which Chevrolet leads all other makes of motor trucks in *sales* is also a direct measure of Chevrolet's leadership in *value*—for trucks are bought by business men who are intent, first of all, on getting the best return on their investment. More and more, they are finding that Chevrolet trucks *pay*—in economy, efficiency and durability. . . . This year, to a greater extent than ever before, Chevrolet's wide variety of trucks—47 models, nine wheelbases—makes the advantages of Chevrolet transportation available to the great majority of business and industrial uses. This variety of models, and their versatility that fits them to so wide a range of uses, also account for a large part of Chevrolet's predominant sales leadership.

CHECK—AND TRIPLE-CHECK
—CHEVROLET TRUCKS FOR
Value
Variety
Versatility

CHEVROLET MOTOR DIVISION, *General Motors Sales Corporation*, DETROIT, MICHIGAN
General Motors Instalment Plan—convenient, economical monthly payments. A General Motors Value.

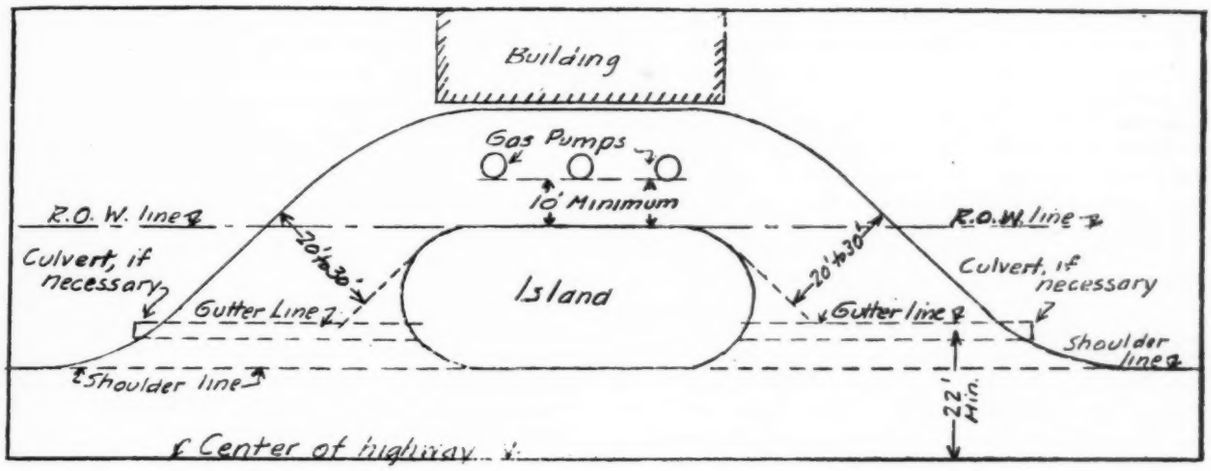
DESIGNED FOR THE LOAD — CHEVROLET — POWERED FOR THE PULL

MASSIVE NEW SUPREMLINE TRUCK STYLING . . . COUPE-TYPE CABS . . . VASTLY IMPROVED VISIBILITY • FAMOUS VALVE-IN-HEAD TRUCK ENGINE • POWERFUL HYDRAULIC TRUCK BRAKES (Vacuum-Power Brake Equipment optional on Heavy Duty models at additional cost) • FULL-FLOATING REAR AXLE on Heavy Duty models only (2-Speed Axle optional on Heavy Duty models at additional cost)

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 50 to 53

PUBLIC WORKS Magazine • • JULY, 1939

Vol. 70 No. 7



Method of Treatment for Filling Station Along State Highway

Filling Station Entrance Design

Contributed by F. H. KLEITSCH, Maintenance Engineer
Department of Roads and Irrigation, State of Nebraska

RULES and regulations for construction and operation of business enterprises along state and federal highways outside incorporated cities, towns or villages have been prepared by the Department of Roads and Irrigation, State of Nebraska.

The use of public property or highway right-of-way for the furtherance of business enterprise is prohibited. Filling stations or other business enterprises developed adjacent to state or federal highways in Nebraska cannot service motor vehicles when parked on public property, highway or street right-of-way. Neither can motor vehicles be parked on public property, highway or street right-of-way when owner or occupants of the same are receiving service at a business enterprise located adjacent to state or federal highways and outside corporate limits of cities, towns or villages.

Owners of such business enterprises are permitted ingress and egress to their property by constructing on public property, highway or street right-of-way two approaches thereto, at the owner's expense. Approaches must be separated by an island or open ditch, if this is necessary, to provide proper drainage. The island must have a minimum length of 30 feet and have a width from normal shoulder line of highway back to the highway or street right-of-way line. The island must be enclosed with suitable guard posts, fence, shrubbery, curb or other approved method so as to prevent parking thereon. If the business is a gasoline service station, pumps must be located a minimum distance of 10 feet back of the right-of-way line if motor vehicles are to be serviced on the roadside side of pumps.

Advertising signs cannot be located on or overhanging public property, highway or street right-of-way.

Approaches must be constructed with 20-foot to 30-foot width with suitable and approved curved connections to highway as shown in the print herewith. Drainage in highway side ditches cannot be altered and the owner of such development must provide at his own expense suitable and approved drainage structures in ditches at approaches.

The surface of the highway must slope out from the center so as to drain away from the center of the highway to the gutter line where curbs are constructed. Where no curbs exist, slope from center out must be for a minimum distance of 22 feet, at which point a gutter line must be maintained to carry highway surface water parallel along the highway to the side ditches. Surface water from adjacent property may be drained toward the highway to the gutter. A shallow gutter, where no curb exists, must be maintained through and over side approaches. Where a curb exists, drainage from property and highway may be to gutter at the curb.

The above requirements do not have preference over city ordinances where these are in effect and the improvement is being made within incorporated cities, towns or villages, in which case local officials are requested to cooperate in order to have the same conditions prevail within corporate limits.

Sewage Treatment Investigations

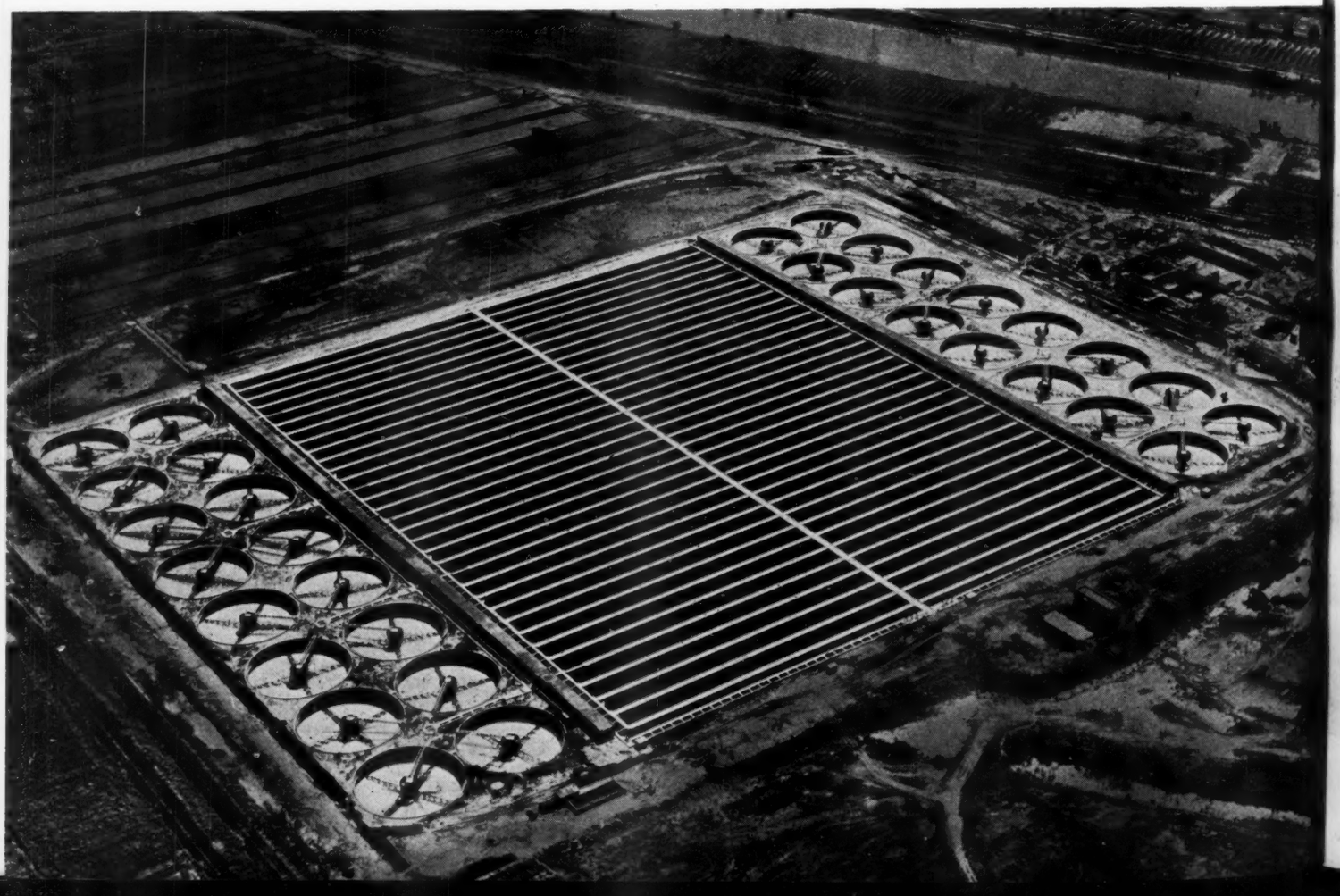
This is a progress report on the work at Chicago, and also a summary of the results of the many interesting varieties of experimental work.

THE Sanitary District of Chicago had, on December 1, 1938, completed sewage treatment works costing nearly 160 million dollars, and expected to spend $14,460,000 additional for works considered essential to the treatment program, $9,030,000 of this in 1939. In addition, nine items totaling $22,940,000 have been deferred. The principal item in this year's work is the completion of the west-southwest works at a cost of $6,830,000.

The total volume of sewage under treatment at the end of last year was 582 mgd. The total population of the district is about 4,684,000, and industrial wastes are estimated equivalent to 1,810,000 additional persons; giving a total population equivalent of 6,494,000. The Sanitary District has assumed that so-called complete sewage treatment could produce an annual average of 85% purification. Hence, so-called complete treatment for the total January 1, 1939, population and industrial wastes equivalent would equal the 100% treatment of the sewage of 5,520,000. The actual treatment at that date included so-called complete treatment of the sewage of a population of 1,741,000; 33 1/3% treatment for 1,722,000 (sedimentation at the West Side plant), and 91% reduction of corn products wastes equivalent to 425,000. This indicates the actual treatment of 44.2% of the total sewage, or 37.7% of theoretical complete removal of pollution from the diluting waters.

The various treatment plants in operation are as follows: North Side Works—Serves a population equivalent of 1,291,000. Activated sludge. Waste sludge pumped to the West Side Works for disposal. West Side Works—Serves a population equivalent of 1,722,000. Imhoff tanks. Calumet Works—Serves a population equivalent of 444,000. Activated sludge. Three small Imhoff tank plants—Morton Grove, Glenview and Northbrook—serve a population equivalent of 6,000.

The Southwest works will operate by the activated sludge process, sludge being dewatered on vacuum filters followed by flash drying and burning in suspension. Part of the sludge from the North Side works will be disposed of here. Under construction are six sludge concentration tanks, each 70x48 ft. with 14.5 ft. water depth, with 3 parallel longitudinal sludge conveyors and one cross conveyor. The Southwest preliminary settling tank sludge, waste activated sludge,



s at Chicago

and filtrate, and North Side waste activated sludge will be brought together and mixed in an aerated mixing chamber.

Experimental work is in progress to determine the best method of improving the Imhoff effluent at the West Side works, whether by chemical treatment, activated sludge or some form of rapid filtration.

Various investigations were conducted at the West Side works during 1938, including tests of high-rate trickling filters, one single-stage and one two-stage; test of plain and chemically treated sewage in Imhoff tanks, followed by filtration through fine-grain mechanical filters operated at a high rate of flow; test of activated sludge process with short aeration period; and test of a small rapid sand filter treating effluent from the high-rate, single-stage trickling filter.

Operation of the high-rate, single-stage trickling filter unit, known as the Halvorsen-Smith aero-filter, was continued through 1938 until November, when it was discontinued. This unit consisted of a filter 20 feet in diameter with an 8-foot depth of stone, followed by a settling tank 12 feet in diameter, with a hopper bottom and a water depth of 11 feet. Crushed limestone from 2 to 3 inches in size was used as filtering medium. Imhoff tank effluent was applied continuously by means of a rotary distributor. A fan for drawing air down through the stone and a pump for recirculating effluent were provided.

During 1938 the filter was operated at a rate of approximately 30 million gallons per acre per day. Neither the forced ventilation nor the return of effluent was used during the year. Air was admitted to the under-drains through a series of 2-inch holes drilled at 30-inch intervals around the bottom of the tank.

On November 1, 1937, new nozzles which impart a whirling motion to the jet, producing a rain-like spray over a relatively large area, were installed on the distributor arms. The filter operated at these high rates without clogging. Filter flies were practically absent as long as the filter was in operation.

Tests on the high-rate trickling filter known as the Jenks bio-filter were continued until November 1, 1938. This unit includes two stages, each consisting of a filter 15 feet in diameter containing stone three feet deep, a hopper-bottom settling tank, a recirculating pump, and necessary control and metering apparatus. The stages were operated in series. The filter medium was crushed limestone. In the primary-stage filter the stone ranged in size from 1½ to 2½ inches, and in the secondary filter from ¾ to 1¼ inches. The settling tanks for the primary stage and secondary stage were 10 feet and 14 feet in diameter, respectively, with a water depth of 11 feet.

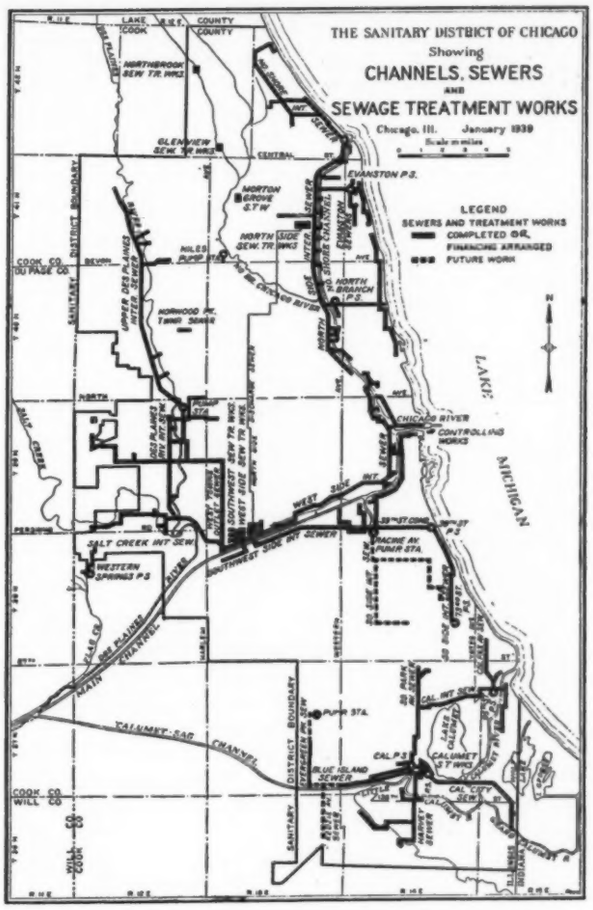
Imhoff-tank effluent was applied to the primary-stage filter. The effluent of this filter passed to a sump, from which it was pumped to the settling tank. A portion of the settling-tank effluent was returned to the incoming flow and passed through the filter a second time and the remainder passed to the second stage where the process was repeated. The unit was operated at rate of approximately 25 million gallons per acre per day on each filter, based on Imhoff effluent flow, until March 15th. From then on the filter was operated until August 31, as a single-stage unit, using only the secondary filter (fine stone), at rates varying from approximately 22 to 30 m.g.a.d. From September until the tests were discontinued, November 1, the filter was operated as a single-stage unit as above, but without recirculation of effluent, at a rate of about 30 m.g.a.d.

The experimental chemical precipitation plant was operated through 1938. The plant consists of a chemical control house, mixing tank, flocculation tank, settling tanks, downward-flow magnetite filters, and a pump for pumping raw sewage from the main plant influent conduit. Sewage is pumped to an open flume in the chemical control house, where the flow divides into two channels of equal width, one channel feeding the plain sedimentation experiment and the other the chemical precipitation. A weir is located in each channel for measuring the flow. Chemicals for the precipitation experiment are fed into the channel below the weir.

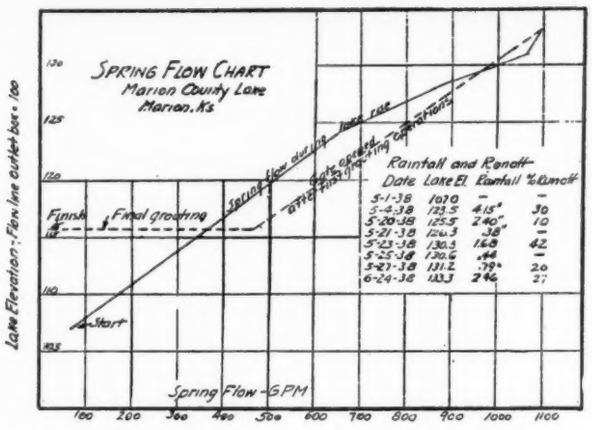
The chemical control house is 24 ft. by 30 ft. in plan, containing two 3,000-gallon tanks for mixing and storing chemical solution, dry feeders for lime and copperas, chlorine control apparatus, a solution and contact box for chlorinated copperas, an orifice box for feeding liquid solutions, and storage space for chemicals.

The mixing tank is divided into three compartments, each 6 ft. by 10 ft. in plan and approximately 7½ ft.

(Continued on page 28)



An air view of the Chicago Southwest treatment plant
Courtesy of the Dorr Company



Grouting to Prevent

THE Marion County Dam was begun in 1936 by the Soil Conservation Service as a State Lake Project, the Kansas State Fish and Game Commission being the sponsor and supervising that construction; but during the first few weeks of the construction the sponsorship was transferred to Marion County, which transfer required the approval of the plans by the Division of Water Resources. This approval was given conditionally, the Division being concerned about an apparent leakage under or around the east abutment. The circumstances and procedures connected with this leakage and efforts to remedy it presented interesting features from an engineering point of view.

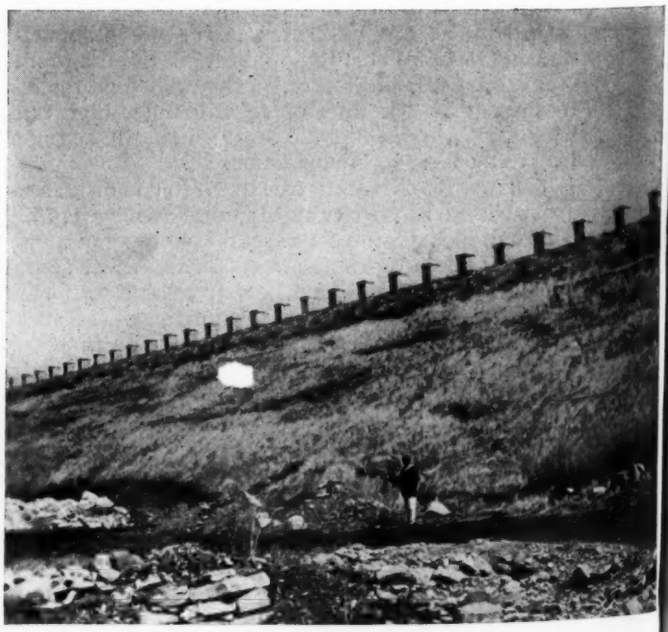
The dam is of earth construction, about 1200 feet long, 300 feet wide with 3:1 upstream side slopes below the riprap and 2:1 slopes in the riprap and downstream, and has a 30-foot roadway across the top at elevation 154.00. An 18" outlet box is located at the lowest point in the lake at elevation 100.00. The spillway, located approximately 100 feet east of the east abutment, is 200 feet wide, designed for constant depth flow as it drops on a 25% grade from a spillway crest elevation of 147.00.

A puddle core was carried approximately 18 feet below the valley surface into 2 feet of solid rock and up 28 feet into the dam. It was carried about 25 feet into the west abutment into solid stratified ground; and was excavated over 100 feet into the east abutment in an attempt to find solid stratified material, but no evidence of solid material was found. A meeting of the interested officials was called and, on petition of the S. C. S., it was agreed to backfill the insufficient east trench and trust that leakage would not occur around this east abutment; it being considered more economical to grout any actual leakage that might occur rather than to move the enormous yardage of unclassified excavation to maintain an open trench over 60 feet deep and in all probability over 200 feet long. On this basis the dam was completed. None of the operations in completing the dam affected the flow of 56 gpm from a spring located approximately 500 feet downstream from the center line of the dam and flowing from the east abutment.

On May 7, 1938, a heavy rain raised the lake to elevation 124.6 and caused the spring to flow about 650 gpm and run quite muddy. Subsequent rains steadily raised the lake until on June 24, 1938 the lake elevation was 133.3 and the spring flowed approximately 1,095 gpm. Geo. Knapp, Chief of the Division of Water Resources, visited the dam and reported that in his judgment the leakage could be cured only by properly drilling and pressure grouting as previously agreed upon.

Meantime the S. C. S. had been excavating for a stilling basin at the end of the spillway, 500 feet below the center of the dam, and water began coming up as a spring through the bottom of this excavation in such quantities as to prevent further work. During 30 days the lake lost about 41,000,000 gal., and, allowing for evaporation and inflow, it was assumed that the lake was losing 45,485,300 gallons every 30 days on a 32 foot head. It was decided to begin at once on exploratory work and test grouting by core drilling, the work to be done by the S. C. S. subject to the supervision of Marion County with the approval of the Division of Water Resources.

Holes of 4" nominal diameter, located 10 ft. apart, on or near the center line of the puddle trench, and extending for about 300 feet east from the east end of the embankment, were made with a core drill and cased for a few feet from the surface, or to a point just under a heavy ledge of rock which was to act as spillway floor. The most significant finding from this exploratory work was that there was a zone of porousness on a fairly uniform plane at approximately ele-



Lower face of dam

Leakage Around an Earth Dam

Leakage of over 1,000 gpm below an earth dam was thought to be around one end of the core wall. By exploratory drilling and pumping in grout under high pressure (meantime developing a procedure that is explained), the leakage was practically eliminated.

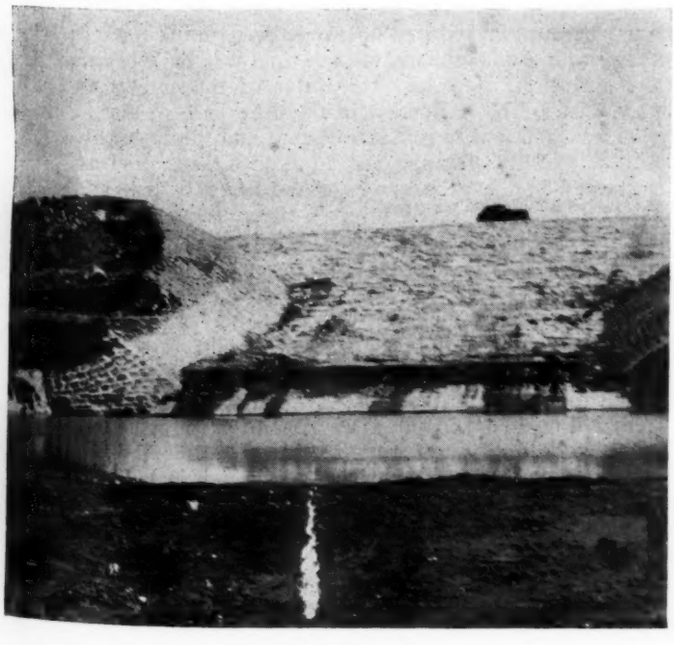
vation 100.00 with a dip toward the dam; also that the spring became muddy in about 8 minutes after drilling into this porous stratum. On the basis of these findings it was decided to grout this porous zone along the line of the dam, eastward until solid material was reached.

Grouting Procedure

In selecting materials for the grout, clay, silica, rock dust, cement and "aquagel" were tested, and a mixture of 1 part cement, 12 parts clay and 1 part aquagel was selected, the last increasing the flowability and density. (Later it was found that the value of the aquagel was largely lost by the time used in mixing and forcing the grout into the porous stratum, and it was discontinued). A sieve analysis of the clay showed that 95% would pass a 100-mesh sieve and 100% a 50-mesh. Efforts to pulverize the clay in a hammermill crusher were unsuccessful because of the moisture in the clay, but by screening it through a ¼" screen a smooth grout was obtained.

The grout was forced into the core holes already drilled and cased, using a mud jack, a 2-cylinder piston pump machine driven by a gasoline engine and capable of creating pressures of over 300 lb. per sq. in. The materials, measured in buckets, were dumped into the jack and sufficient water added to give it the consistency of thick cream as it flowed into the pressure cylinders. In several cases the pressure so applied caused cracks and holes to appear in the embankment near the hole, or cracks in the parapet wall. In grouting one hole, the grout emerged in the spring 500 feet away, even when sand, sawdust, oats, straw, paper, etc., were mixed with the grout in a desperate attempt to clog the underground channel and prevent the grout from washing through the spring. Finally a mixture of straw, clay and cement held in the stratum, and the flow of the spring fell from 824 to 637 gpm.

James F. Meisner



The spillway section

This completed the series of grouting through the core holes and reduced the flow from a maximum of 925 gpm to 637 gpm. Further reductions could not be made until a new series of holes were drilled. A meeting of the S. C. S., Division of Water Resources, and Marion County was held in which future operations were outlined.

The grouting had been done without draining the lake, which now stood at elevation 127.3, due to a strong feeling of the public that the water in the lake should be saved if possible; but this had definitely increased the difficulty of clogging the porous stratum with grout while water was flowing under this pressure through it. It was therefore decided to lower the lake before continuing the grouting; to grout the holes consecutively; to drill new holes down to elevation 85, at 10 ft. intervals, 15′ upstream from the original line of holes, until the limit of the underground flow was reached, and case them immediately with grouting pipe carried down to elev. 98.0 and sealed in the hole at elev. 105.0. Before grouting any hole, a grouting pipe was to be set and sealed in the next hole and arrangments made to learn the exact time when grout appeared in this hole and the height to which it rose;

such grout being flushed out immediately after grouting ceased in the adjacent hole. Grouting was to be continued uninterrupted to refusal, or until grout rose at least 5 feet above the bottom of the pipe in the adjacent hole, or was forced out of the spring or stilling basin undiluted and continued to flow steadily, or until a crack appeared in the embankment or grout was forced out to the surface. The grouting mixture was changed to 6 parts of clay to 1 part of cement, and the use of sawdust or other organic material was abandoned as it was felt that temporary clogging of the stratum would not be necessary if the lake water was not flowing through in volume and under pressure.

During the grouting records were kept of:

1. The amount of material placed in each hole.
2. Proportions of the mix.
3. Time of operations, delays, tally of buckets of material with time interval recorded for each 5 buckets dumped.
4. Discharge of spring and stilling basin before grouting operations begin, at intervals during the period of grouting, and at the end of grouting of each hole.
5. Exact depth to which each hole is drilled and jetted open.
6. Exact length and size of pipe in each hole, with elevation of top of pipe in relation to top of hole.

A contract was let for drilling 6″ holes, and an effort was made to reclaim, by jetting, the holes previously grouted. Seven holes were drilled to elevations between 83.2 and 83.9, the ground surface being between elev. 152.3 and 155.2.

On Nov. 25, 1938, the gate valve was opened according to the decision to reduce the pressure and flow of the leak, and by Nov. 30, 1938 the lake had been lowered to elev. 115.75. The combined flow of the two springs (spring and stilling basin) before lowering the lake was 637 gpm and after lowering it was 463 gpm, but more important was the reduction in pressure through the leak.

Immediately after drilling a hole to the required depth, a 2″ casing was prepared, a collar made of rubber belting which would snugly fit the 6″ hole being attached to the pipe 7 ft. from the lower end. Except the lowest joint, all joints of the pipe were spot welded to permit recovering the upper lengths. This pipe was then lowered into the hole so that its bottom was at elev. 98.0 and anchored there. A few shovelfuls of coarse dirt thrown into the hole around the pipe effected a seal at the rubber collar, which was immediately followed by 2 sacks of neat cement to make a permanent seal; a measurement then being taken down to the cement to make sure it was properly placed.

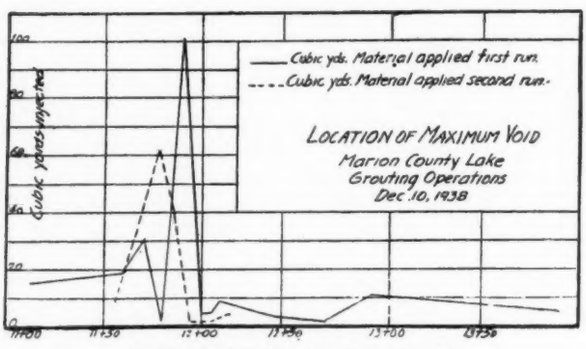


Diagram showing location of voids

Then a gate valve was placed on top of the 2″ pipe, in this a short 2″ nipple followed by a union, a second nipple, and on this a 2×2 T, one branch of which carried a gate while the mud jack was connected to the other. This permitted retaining all pressure developed in the pipe, after disconnecting the mud jack; also reducing the pressure in the hose at will.

The mud jack was equipped with 25 ft. of high-pressure hose, which permitted grouting several holes from one setup. Water for the grout was raised from the lake by a centrifugal pump.

To record the height of water in the hole adjacent to that being grouted, a sounding device was used consisting of a 6″ length of shovel handle rounded at the ends and suspended from one end of a chalk line which ran over a pulley and carried a counterweight on the other end, the pulley being supported over the hole by a tripod. Knots in the string indicated the depth—one knot, 10 ft.; two knots, 20 ft.; etc. During grouting, material invariably flowed to the adjacent hole and took an initial set in it, but was jetted out before it became firm and before attaching the mud jack to the pipe. This jetting was done with ½″ pipe lowered into the hole and fed by a 2″ centrifugal pump. For hard material, a short section of pipe was flattened and sharpened, holes being drilled in its sides to prevent plugging.

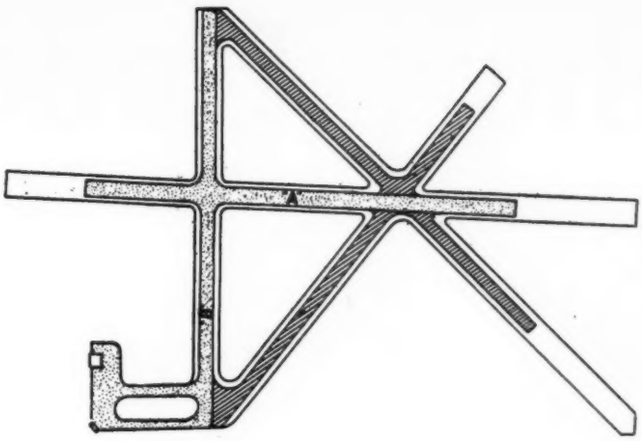
Work was continued night as well as day to prevent material from the last hole from setting and destroying the possibility of a continuous cutoff in the porous stratum. A Homelite plant was used to furnish light for the work.

Grouting began on the second attempt, after lowering the lake level, on the most western hole—11+57—at the rate of a 12 qt. bucket each 0.368 minute, and 1.7 cu. yd. was injected. This reduced the spring flow 28 gpm, although no cloudiness appeared at the spring. (This hole had been jetted open to a depth of 70.9 ft.) A few days later this hole was jetted out again and grouting repeated, when water rose in 11+67 to 7′, in 11+77 to 9′ and in 11+87 to 36′ and the spring roiled badly. In one hour the spring flow fell from 417 to 407 gpm, but grout flowed badly from the spring and it became apparent that the difference in elevation between the spring and lake must be further reduced to retain the grout. Rather than lower the lake more, a small dam was built below the spring which raised the water of the spring to elev. 107.5. This reduction in the difference in elevation was sufficient to retain the grout and the turbidity and flow of the spring decreased at once. Pressure was sustained in the grouting hose and after 1.7 cu. yd. more of gout had been injected the pressure became so great as to shear the key on the jack.

Then 11+67 was grouted, and after an hour grout flowed from 11+77. The valve on 11+77 was closed and grouting continued until 9.4 cu. yd. had been injected, and operations were stopped when grout broke out near 11+92. Next day, after giving the previous grout time to set in the ground fracture, grouting was renewed on 11+67, and, after 30 min. grout came out of 11+97 and water rose in 11+77 and 11+87. After 23 cu. yd. of material had been injected, the spring ran clear, and pressure was built up that sheared a jack key, and grouting was discontinued.

Hole 11+77 was then grouted, after jetting it to 63 ft. depth. A total of 61.7 cu. yd. was injected in 30 hrs. and the spring flow was greatly reduced. Meantime water rose in 12+12 and 12+32 and the parapet

(Continued on page 36)



Albuquerque Municipal Airport

By E. O. BETTS
City Engineer

MADE possible through the assistance of the WPA and Transcontinental and Western Air Incorporated, the City of Albuquerque is constructing an entirely new airport to accommodate the two air lines serving this city. A suitable site of ample size was available within 3.9 miles of the United States Post Office and 2¼ miles of U. S. Highway 66, and without surrounding obstructions.

Four runways, 300 feet in width, are provided; varying in length from 1 mile to 1½ miles. Hard surfaced landing strips, of which two are completed, are being installed on all four of these runways for a minimum length of 1 mile. The importance of the north-south runway for use with an instrument landing system made it advisable to use a hard surfaced landing strip of greater than the conventional 150 foot width, namely, 200 feet.

The availability of a suitable pit run aggregate was a factor in the selection of the type of surfacing used. Large deposits of aggregate adjacent to the field were developed to permit gas shovel loading of dump trucks, and a short haul to the site. This short haul and accessibility to the gravel pits explains the low cost of the completed surfacing.

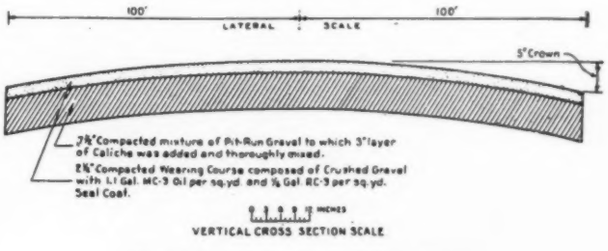
Rainfall in this area occurs over short periods of the year, and then is of reasonably severe intensity. Plans of the runways made use of the conventional side-hill sections to facilitate run-off of surface water under severe conditions. This type of construction was replaced by crowned runways draining to gutters, and thence through under-ground concrete pipe to suitable discharge areas.

Two of the runways have been completed for some time, making available an opportunity to study the effects of the 3 inch crown upon drainage of the surface water. The unusual difficulty of installing the surfacing with sufficient accuracy to afford satisfactory run-off on the particularly flat surface has made it advisable to select a greater crown on the remaining two runways. It is believed that the use of a 6 inch crown on the 150-foot width strip, with a 1% transverse grade on the balance of the runways, will afford a more positive removal of the surface water.

An ideal sub-grade of caliche and clay exists at the site. After rough grading was accomplished, pit run gravel was applied to the area to be surfaced in sufficient quantities to give a compacted base of 7½ inch thickness. The nature of this particular pit run gravel required the addition of a suitable material to supplement the fines in the aggregate. Quantities of caliche, available on the field, were used to make up this deficiency. It required approximately .07 cu. yds. of caliche per sq. yd. of runway surface to give the required grading of material. After thoroughly discing the mixture, sufficient moisture was added and the base material rolled. No other binder was added to this base material.

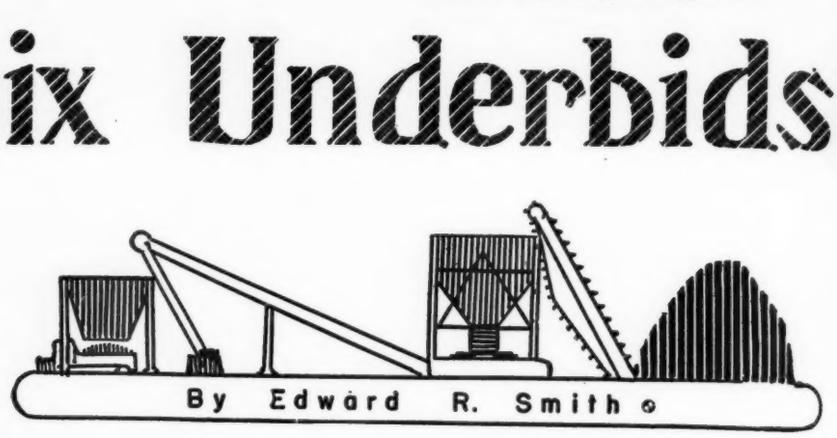
The wearing surface was composed of 2½ inches of compacted mixed-in-place surface. This consisted of crushed and screened rock of a graded size up to ½ inch, to which approximately 1 gal. per sq. yd. of MC-4 was added and mixed with blades. Spreading and shaping of the wearing surface was done with blades. After rolling, a seal coat of 1/6 gal. per sq. yd. of RC-3 was applied with a pressure distributor. No blotting operation was used.

Exclusive of skilled labor and supervision, the cost of the base, caliche binder, wearing surface and seal coat was approximately 35c per sq. yd. in place.



Albuquerque, N. M., Municipal Airport

Plantmix Underbids



By Edward R. Smith

WALLA WALLA COUNTY, in southeastern Washington's wheat and pea district, is served by an excellent highway system 1,110 miles long. This consists of 8 miles of concrete pavement, 140 miles of light bituminous surfacing, 350 miles of crushed stone and 612 miles of earth road. The county has 181 bridges. Some $200,000 derived from property and gasoline taxes is available each year for county road work; 70 per cent is spent for new construction, 25 per cent for maintenance and 5 per cent for overhead, all under state supervision.

Most of the county's roads are "streamlined" with a well crowned section, sloping shoulders and without any deep and dangerous ditch section. A few of the main roads are paved to 18, 20 and 27-foot widths, with shoulders of sod or gravel ten feet wide. The larger mileage, however, is made up of a bituminous mat 16 feet wide, flanked by 8-foot shoulders having a 10 to 1 slope. This turnpike section does away with any flat and narrow roadway as well as troublesome ditches.

On June 13, 1938, Walla Walla County opened bids to oil, by the roadmix method, some 35 miles of county road in the vicinity of the city of Walla Walla. Eleven bids were received ranging from $52,730 down to $42,350. Ten of the bidders planned to do the work in the orthodox way, by hauling the crushed stone from a centrally located stockpile and then mixing the material

Left: Top, the mixing plant, and below, the spreading box. Spreading and smoothing with a motor grading. At bottom, 2 weeks after oiling. Note flowers undisturbed by oil.

Roadmix

Of eleven bids for 35 miles of work, ten were for roadmix, but the lowest was for plantmix and was accepted. The entire 35 miles of 16 ft. by 1½ in. surface was hauled an average of 6.5 miles from the mixing plant, spread and rolled in 16 days. Plantmix gave a uniform mix in place, perfect control of oil and gravel proportioning and other advantages, including speed of construction.

Edward R. Smith

on the roadway by means of motor patrols and a distributor. The eleventh and lowest bidder proposed to coat the rock with oil before hauling, the method having been worked out by Howard Green, whose Standard Asphalt Paving Company was awarded the contract.

To encourage bids on this contract work, 400 information sheets giving a map and a brief description of the project had been mailed to contractors, bondsmen and material dealers. The specifications called for a tack coat of 0.3 gallon per square yard, 0.7 gallon in the mix, and 0.1 gallon as a fog or seal coat, the mat to be 1½ inches thick and 16 ft. wide, with thickened edges. SC-2 road oil was specified. All work and the oil were to be included in a lump sum bid, but not the gravel.

The thirty-five miles to be oiled was distributed over seventeen separate sections radiating from the city of Walla Walla. The stockpile was located at the east city limits, giving an average haul of 6.5 miles. This pile contained 17,500 cubic years (or 500 yards per mile) of clean, crushed creek gravel, carefully graded and built up in four-foot lifts. The aggregate was ¾-inch minus, 60% passing a ¼-inch screen, 4% a 200 mesh.

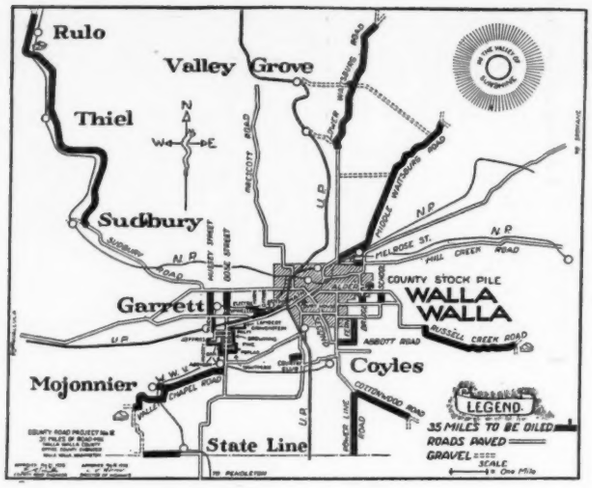
Narrow, steep and crooked roads to be oiled had been graded to line, slope and width (usually 32 feet) before the contract was let. These graded roads were then given a covering of 6-inch minus creek gravel, loaded by a power shovel into trucks direct from gravel bars, and brought to a firm, smooth surface. Just previous to oiling, a thin coating of crushed rock, 200 yards to the mile, was bladed over the road, wet down with sprinkler trucks, and traffic rolled. Roads which were already passable as to grade, alignment, width and metal were patched, wet down and tight bladed. Where the oil mat was to cross over a bridge having a worn and loose plank roadway, the decking was spiked tight and a new covering of 2x12 plank laid longitudinally over the old transverse 4x12 planking.

The first tack coat was applied June 27—0.3 of a gallon per square yard of SC-2, heated to 250 degrees with an atmospheric reading of 90 degrees. Specifications called for tight blading just ahead of the distributor. Half of the road was shot at a time, using an 8-foot spray bar. The roadbed was hot and the oil went right in, and was not covered with rock. Two flagmen wearing red helmets and red coats kept traffic off the fresh oil and warned drivers to use caution. One week after application, the tack was dry, firm and hard. The oil was heated at a spur inside the city limits.

In preparation for tacking, all roads were marked out with stakes whitened with cold-water paint and set 15 feet from the center line at 100-foot intervals. Just before tight blading, one of the flagmen, using a 7-foot stick, measured from the white markers and nailed white papers along one side of the prepared and dampened grade exactly eight feet from the center line. These papers, readily seen from the distributor, served to line up the tack.

Under the shadow of the comparatively huge stockpile the Standard Company erected its mixing plant, consisting of two bins and conveyors, pug mill, vats, heater and Diesel power plant. There was no dryer. Batches were weighed in the proportion of 2,000 pounds of rock to 75 pounds of road oil and mixed thirty seconds. On July 7 the plant began operation with 15

Left to right, Howard Green, E. L. Hiatt, Len Melville, and George Howatt and Roy Dawson.



Map showing project layout.

3½ ton trucks, starting on the long haul of 16 miles. On reaching the far end of the project, a spreader box on wheels with a "V" opening was fastened by chains to each truck and pulled some forty feet down the center of the tack or prime coat, leaving a straight windrow of uniformly mixed mat material.

The upper layers of the stockpile had become soaked by rain, and a motor blade was put to work drying the material by turning it over. Although damp, the aggregate mixed readily with the oil in the pug mill and as high as 120 tons per hour were produced and taken from the plant. As the stockpile was used and the lower, dry layers were uncovered, it was found that the rock mixed faster with the oil when wet down with a garden hose. As the haul decreased, fewer trucks were required. Two shifts were used, work starting at 4 a.m. and running till 8 or 9 in the evening.

As each truck came up to dump at the spreader box, the driver was handed a duplicate ticket stamped serially and marked with the number of the road section. Thus the contractor and the engineer office each had a check on the amount of material put on the project.

This method of plantmix in place of roadmix proved a success from every angle. Mr. Green stated that in all of his 26 years of plant experience he had never had a faster moving operation, or as many tons per hour.

As the mix was being windrowed on the road, one of the flagmen nailed white papers along the edge of the tack to mark the limits of the mat, measuring from the white fifteen-foot offset markers. The layout man, with an Austin-Western "77" motor patrol, flattened the windrow and then cut grooves along the white papers for the thickened edge and laid the mix to a smooth surface. Day after day (16 days) this man finished two and one-half miles from sun-up till dark. The part laid was immediately rolled with an eight-ton roller. A second rolling followed the day after being laid.

July 11, or four days after laying, that part of the road which was finished and partly compacted by traffic, was given a seal or fog coat of from 0.1 to 0.15 gallon of oil per square yard. With roadside temperatures of 80° to 110° and road readings of 100° to 130°, the oil, heated to 250 degrees, immediately penetrated the mat. There was no cover, yet the oil was dry within a few days. There has been no bleeding.

The following advantages appear evident in this method of plantmix over roadmix: The mix is uniform, without fat or lean places. The fines are evenly distributed in the edge portion as well as the center. There is no dust or oversize gravel mixed into the mat. It permits the use of large-size and cheap base rock directly beneath the mat. Road connections, intersections and short sections are more easily constructed. Faults in the base are quickly remedied by the use of an additional load of the mix. There is perfect control of rock and oil, permitting the use of the minimum amount of roadoil.

Plantmix has these apparent disadvantages: The floor is not built up to the uniform smoothness achieved in roadmix, with the result that the mat has a varying thickness and the riding qualities are inferior to roadmix. Material existing as part of the old road cannot be salvaged for use in the mat.

A slow curing oil, SC-2, was used on this project partly because it served the purpose, as well as retaining its life longer than a cutback oil, and chiefly for the reason that the price in place was twenty to thirty-five per cent cheaper than the lowest priced medium or rapid-curing liquid asphalt.

The Board of County Commissioners in Walla Walla County is composed of M. C. McCown, Chairman, Harry Reynolds and Elmer Markham. Len Melville was superintendent for the paving company. E. L. Hiatt was manager for the Union Oil Company supplying the road oil. Fred Gloor represented the state as engineer of state aid highways, Kenneth Groves served as oil inspector for the county with E. R. Smith, county road engineer, in charge.

Liability Under Waterworks Extension Contract

In a contractor's action against a city for loss of prospective profits under a contract for the installation of extensions to the city's water works system, the city pointed out that the contract recited that funds to finance the work were to be procured from PWA; that these funds had never been received, and that the contract provided that the city would make payments to the contractor "only as the money is made available" by PWA. The Fifth Circuit Court of Appeals said, however (City of Del Rio v. Ulen Contracting Corp., 94 F. 2d., 701) that the city voluntarily abandoned its financing contract with PWA because it was dissatisfied with the delay, and immediately proceeded with the construction project through a purported contract with another contractor, paying for the work with funds secured from another source. It was held that the city could not thus escape from its liability to the contractor. Judgment for plaintiff in the Federal District Court for Western Texas was affirmed.

How to Paint Your Swimming Pool White

The following are specifications for a white swimming pool paint which is used by the Milwaukee County Regional Planning Department.

"All interior concrete surfaces are to be scraped clean of foreign matter and washed down with a hose. The surface is to be damp or wet at the time of application. Then make a mixture consisting of 100 pounds of hydrated lime, 50 pounds Atlas White cement, and 10 pounds of common table salt, this mixture to be stirred in with water until it makes a gravy-like or paint consistency and the salt is fully dissolved. Apply this to the wet surface, using a heavy white wash brush. A two-coat application can be given one day apart. Allow 24 hours drying after the final coat has been put on. Then turn the water back into the pool."—Illinois Department of Health.

The Editor's Page

Grasshopper Poison and Water Supplies

Campaigns to poison grasshoppers involve the use of considerable quantities of arsenic. Not enough is generally spread to cause danger to water users if a rain occurs and washes the poison into streams, but two years ago in North Dakota a sudden cloudburst washed away a bait-mixing plant and carried two tons of arsenic into the Yellowstone River. An occurrence such as this when the dilution was insufficient would be dangerous to anyone or anything using the water.

It is not difficult to determine the presence of arsenic in water, but exceedingly difficult to remove it. Therefore, in case of suspected trouble, the plant should be shut down. Traces of arsenic in water do not make water dangerous. Your State Board of Health will advise on specific amounts. William Yegen, president of the North Dakota Water and Sewage Works Conference, suggests that water works officials, in areas where arsenic is being used to combat grasshoppers, should arrange with the county commissions to locate bait-mixing plants where floods will not affect water supply sources, and to limit the amount of arsenic at any one point to fifty pounds.

Highways As Income Producers And Public Benefits

In looking over the sources of revenue of New York State, which had a total income last year of a little over $400,000,000, it is of interest to note that motor taxes, motor vehicle licenses and motor fuel taxes brought in close to $100,000,000. This was, by far, the largest single source of income to the state. But New York state did not spend anything like $100,000,000 on highway construction and maintenance.

According to a recent study, the logical and proper charges against the highway user should include interest on highway indebtedness, amortization of cost over the service life of the highway, administrative expense, maintenance and operation — including repairs, renewals and replacements—and policing cost of highways. But these certainly do not consume a quarter of the total income of the state.

It is not always possible to estimate at all closely the value of a road, from the income standpoint, but in most cases an approximation can be made. In many rural sections, a new road may serve only 40 families: if these did not have cars because of previous poor road facilities, but if half of them purchase cars when an all-weather road has been built, the tax income alone from these 20 cars on the basis of average use would be in excess of $500 a year. (To the tax payers who own the cars the saving in time and wear on vehicles would be several times this).

Highways should not be considered a profit-making enterprise, even though they do pay their own way, and in some cases do more than this. There are other values that cannot be considered from the money viewpoint — better school facilities, better medical and health services, better police and fire protection, improvement in property values, and many other items. As we have said before, in most states the highway system is the greatest single asset of the state.

Getting Ready for Cold Weather

With the temperature up around 90 and the humidity even higher, if possible, this is a good time to think about snow fighting along next winter. Select a cool place, if one is available, and consider the snow fighting problem, the highways to be cleared, schedules, plows and motive power that can be used; then check over the equipment that is on hand and determine what is needed to equip your department. Finally, think up a good selling talk and present it to the fiscal authorities.

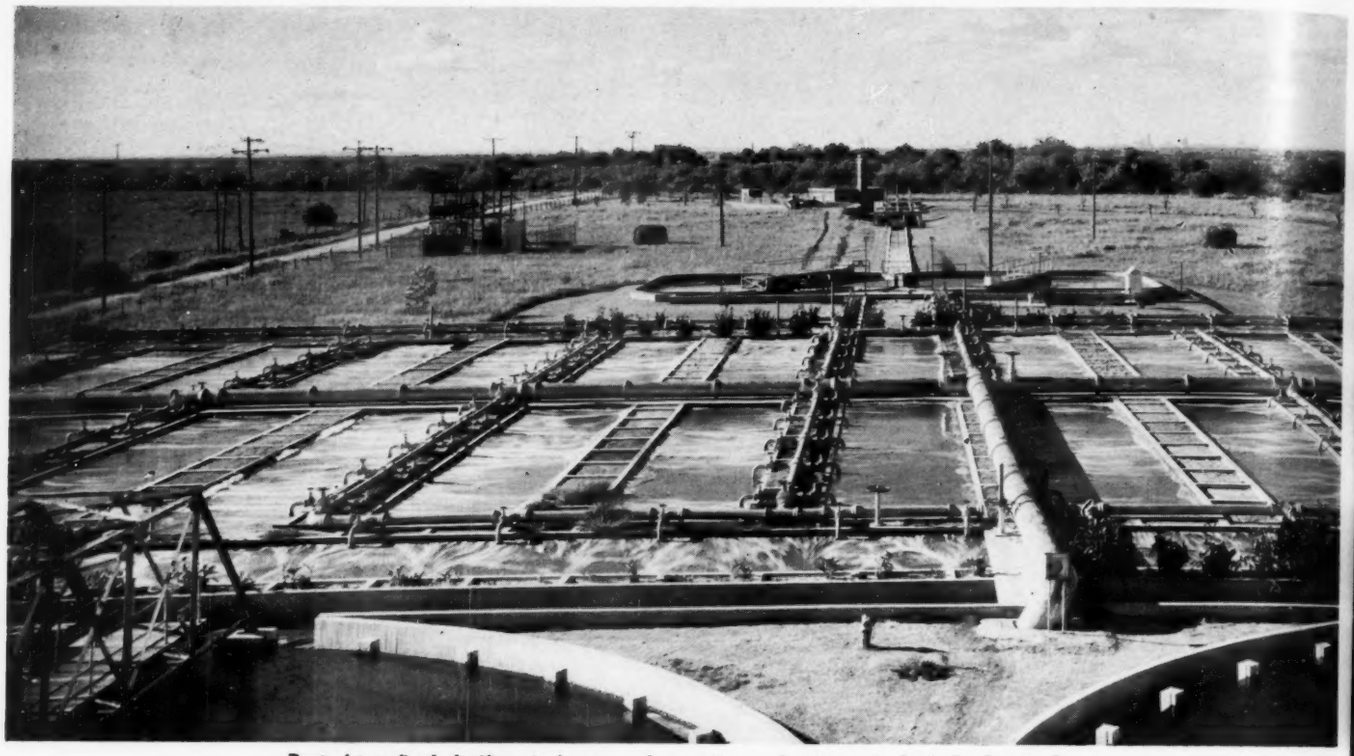
That is the best kind of cold weather preparedness—far better than waiting until some of those Model T plows and antique trucks break down in the middle of a big drift 9 miles from nowhere. Of course, when that happens it won't be so hard to get an OK for required new purchases, but the road users will be out of luck.

In the east, at least, last winter was a bad one for the highway engineer and street superintendent, and a good one for the plow makers, though they probably won't admit it. We do not risk a prophecy, and remembering our long, long stretch of front walk, we prefer to forget the matter—which is exactly what too many of those charged with snow removal also prefer to do.

Conservation of Our Resources

A century ago alarmists urged stern measures against too rapid destruction of the sperm whale, else their descendants would have to rely on candles for light. The next generation of alarmists denounced the waste of kerosene oil for the same reason. Their children were aghast over the sinful waste of natural gas and coal, seeing the approach of a world without light or heat. In 1908 geologists and oil men estimated the entire reserve of crude oil in the ground at an amount less than what has actually been withdrawn since then. And yet, according to T. G. Delbridge, petroleum technologist and president of the American Society for Testing Materials, "the estimate for January 1, 1939, was 17,348 million barrels, the highest in the history of the country," due to "advanced methods of exploration, drilling, production and refining. . . . New methods are being applied to old fields believed to be exhausted, and they again are in production."

This is not an argument in favor of waste, but against those who would have us deny ourselves the supplying of reasonable desires out of consideration for our descendants. The extravagant generation is the only one that suffers; the following one will find even better substitutes for exhausted resources or that the resources were not exhausted after all.



Part of two final clarifiers in foreground; aeration and primary tanks in background

Principles of Designing and Operating Ac

By E. J. M. BERG

Chief Chemist and Superintendent San Antonio, Tex., Sewage Treatment Plant

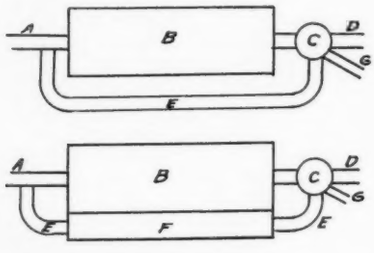
This text was read by Langdon Pearse, Don Bloodgood, Frank Bachman and H. W. Gillard in order that variations in practice due to climate and geography be covered adequately, and that plants using mechanical aeration be given consideration. Suggestions by Messrs. Pearse, Bloodgood, Bachman and Gillard have been incorporated into the text by the Editors.

FROM the definition on page 21 it follows that the activated sludge process falls into the following steps, assuming that an activated sludge floc has been previously formed:

1. Mixing of the activated sludge with the sewage to be treated.
2. Aeration and circulation of this liquor for the required length of time.
3. Separation of the activated sludge from the mixed liquor.
4. Return of the proper amount of activated sludge to the aeration tank inlet.
5. Disposal of excess activated sludge.

The diagrams herewith illustrate the process schematically.

In both figures, A is the line carrying the raw sewage (presumably from a preliminary settling tank) into the tank or set of tanks where it is to receive its aeration



treatment. E is the line bringing the settled activated sludge from the final sedimentation tank to the aeration tank inlet. There may be a special tank where incoming sewage is thoroughly mixed with the returned activated sludge for a short period. This mixed liquor then flows to tank B, where it receives the required amount of atmospheric oxygen by any one of a number of methods to be described later. During this aeration and circulation process, the amount of activated sludge floc increases, and with the proper time of contact, reduction of organic matter proceeds. From B the mixture of activated sludge and treated sewage flows to the sedimentation tank C. Here the sludge settles and the scrubbing action of the floc as the sewage passes through it, in addition to the reduction of organic matter accomplished in the aeration tank B, aids in producing the clear, odorless, effluent to be expected from this type of sewage treatment. The amount of settled activated sludge needed to seed the incoming sewage is drawn off through E. This sludge is sometimes passed through an aeration tank F, to be re-aerated before it is mixed with the incoming sewage. As has been stated, the amount of sludge in the aeration mixture increases during treatment. Hence there is an amount of "excess sludge" drawn off at G, which must be disposed of.

A well designed and properly operated plant can consistently produce a suspended solids and B.O.D. reduction of 90% to 95%. This necessitates a detention period of about 6 hours in the aeration tanks, sufficient mechanical aeration or diffused air to maintain the necessary aerobic conditions and a detention period of about 2 hours in the final sedimentation tanks. For a diffused air plant from ½ to 1½ cubic feet of air per gallon of sewage will provide sufficient aeration. These figures assume that the suspended solids and B.O.D. of the raw sewage average 250 and 180 p.p.m. respectively. These are approximate and average figures and they may be greatly influenced by variations in sewage strength, especially such sudden variations as large quantities of slaughterhouse or other industrial wastes.

As defined by a committee of the Sanitary Section of the American Public Health Association, "The Activated Sludge Process consists in the agitation of a mixture of sewage with about 15 per cent or more of its volume of bacterially active liquid sludge in the presence of ample atmospheric oxygen, for a sufficient period of time to coagulate at least a large proportion of the colloidal substances, followed by sedimentation adequate for the subsidence of the sludge flocculi; the activated sludge having been previously produced by aeration of successive quantities of sewage and maintained in its active condition by adequate aeration by itself or in contact with sewage."*

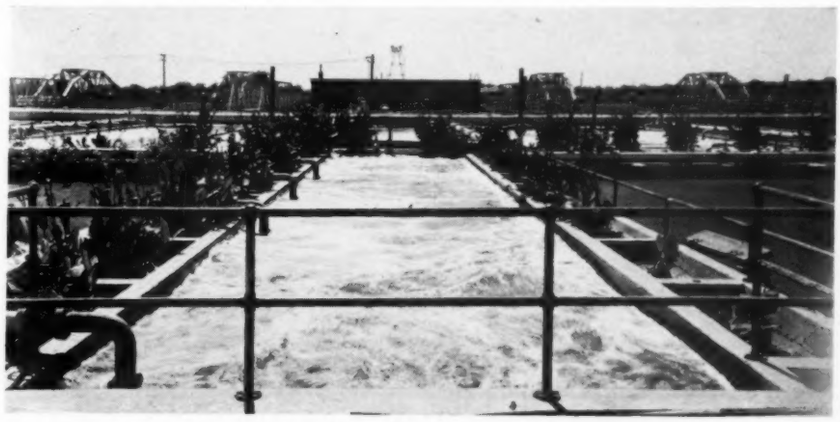
ng Activated Sludge Plants

Fundamental Principles of Design

Mixing and Aeration Tanks. It is of extreme importance that the activated sludge returned to the raw sewage be intimately mixed with it. Unless each portion of the incoming sewage receives its proper portion of the returned sludge, the treatment process cannot be properly accomplished. If a separate mixing chamber is used the method of mixing will probably be the same as that used to aerate the activated sludge and raw sewage mixture (mixed liquor) in the aeration tanks proper. The size of the mixing chamber depends, of course, on the amount of mixed liquor flowing through it per unit of time. As with all other units of any sewage plant, it must be borne in mind that the sewage flow fluctuates, and the units must be so designed that there is no great change in the liquor level between times of high and low flow. A change in level amounting to as much as 8 inches would interfere with any type of aeration and would prevent the proper functioning of the final sedimentation tanks. Mixing may be accomplished by adding the returned sludge to the incoming sewage ahead of the inlet to the distribution channel at the aeration tank inlet, in such a manner as to obtain a thorough mix. Where air diffusion is used, the distribution channel may be fitted with diffuser plates to obtain adequate mixing. Each aeration inlet should be provided with an inlet valve or sluice gate so that the flow to each may be controlled according to its particular performance. Each aeration tank may be either one long continuous channel, or each may be a series of three channels so arranged that the mixed liquor flows down one channel, then across to another and back in the opposite direction to its first flow, then across to the third channel and from it to the final sedimentation tanks. The figure shown on page 22 illustrates this arrangement, using two aeration units.

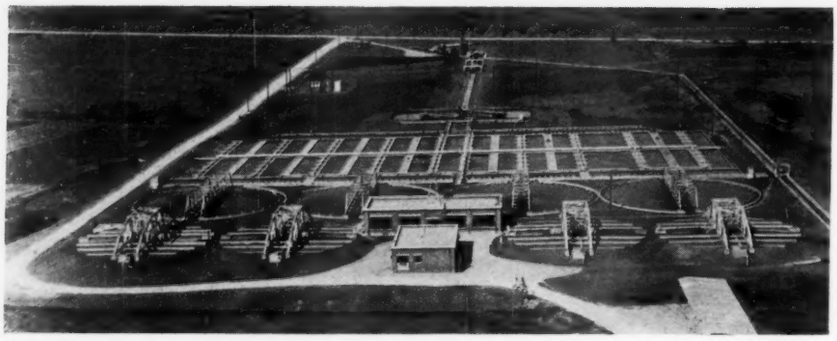
The fundamental principles involved in the design of the aeration tanks, considering the treatment process only, are as follows:

The reactions involved take a certain



Close-up view of the aeration tanks, San Antonio plant

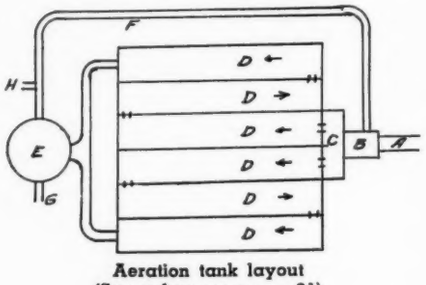
*American Journal of Public Health, Volume VII, Page 847.



General view of San Antonio plant

amount of time; during which the liquid must be kept thoroughly agitated and must receive sufficient atmospheric oxygen to maintain an active sludge. A diffused air plant will require from ½ to 1½ cubic feet of air per gallon of sewage.

During the early part of the aeration period the demand for oxygen is at a maximum. The actual demand is higher with a more concentrated sludge, but the time of



Aeration tank layout
(See reference on p. 21)

A—raw sewage enters; B—mixing tank; C — distributing channel; D — aeration tanks; E—final settling tank; F—sludge return line; G—effluent line; H—excess sludge line.

this high rate utilization is shorter. Secondly, the sludge absorbs a certain amount of oxygen from the atmosphere as it passes through the tanks, hence a longer aeration period may conserve power required for aeration, but the cost of aeration and circulation may outweigh this advantage. The strength and type of sewage to be treated must be considered in determining the volume of the aeration tanks.

Aeration and mixing may be accomplished either by air diffusion, that is forcing the air into the sewage through porous plates or tubes placed in or near the bottom of the tanks; or mechanically, by means of rotating impellers, brushes or paddle wheels designed to aerate, agitate and circulate the sewage sludge mixture; or there may be a combination of the two systems. If the diffused air method is used, the diffusers may be placed in checkerboard fashion over the whole bottom of the tank; or they may be placed along one side of the tank, thus imparting a rotating motion to the sewage and sludge mixture. This rotating motion is further increased by the use of fillets and baffles. Thus in addition to oxygen absorbed from the air blown through it, the mixture absorbs a large amount of atmospheric oxygen at the aeration tank surface.

This method of aeration determines the depth and width of the tank used. In general, diffused air systems use tanks from 12 to 15 feet deep, and approximately twice as wide. Mechanical aeration tanks, using paddles or rotating brushes, usually are 4 to 6 feet deep and about 12 feet wide. Other mechanical aerators, many of which are in successful service in the United States, require tanks 20 to 30 feet in width with depths varying from 10 to 16 feet. Mechanical aerators of this general type are available from a number of manufacturers. A typical cross section of a single aerator unit and tank is shown on p. 23. Economical plant design usually limits these mechanical aeration devices to plants required to handle sewage flows from contributing populations not greater than twenty thousand. Local conditions, such as amount and organic content of sewage, the amount and type of industrial waste mixed with it, cost of construction as determined by excavation and type of foundation required, have a material influence in determining not only the type of aeration to be adopted, but also the size and shape of tank most economical and desirable.

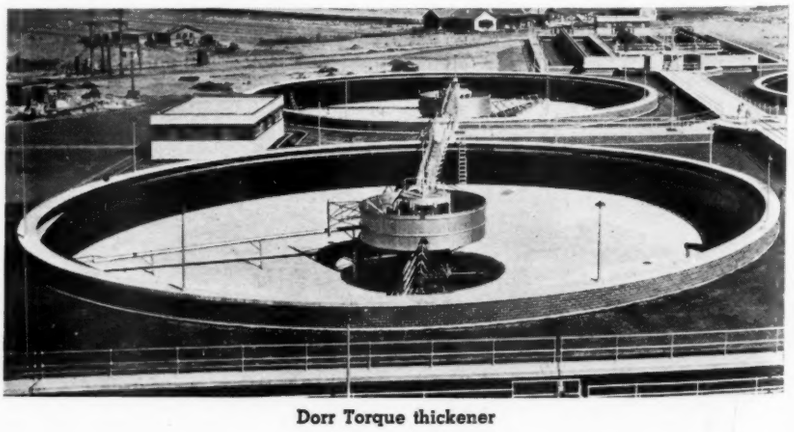
Aeration Equipment. The importance of the selection of the means of maintaining the necessary aerobic conditions in the aeration tanks, whether of the diffused air type or the mechanical surface aeration type, is of prime importance. This apparatus constitutes the very heart of an activated sludge plant. Its failure or lack of capacity will result in complete failure or inadequate treatment. Flexibility is desirable to aid in economical handling of the varying flow rates usually encountered in a sewage treatment plant. Mechanical aerators are available which include adjustment features, permitting variations in discharge rates of the order of 3 to 1. Selection of air blowers or compressors for the diffused air type plant should also be made with a view to flexibility in operation. If it is at all possible, there should be at least three units of such capacities that the largest unit takes care of the average flow, the smallest unit may be added to it for peak flows, and the medium unit may be used for extremely small flows, or at times it is necessary for the plant to be by-passed, or as a standby with the smaller unit in the event of mechanical trouble with the larger unit. Increased flexibility will make for greater economy. There are two general types of compressors—centrifugal, built on the same principle as the centrifugal pump, and positive displacement compressors, of which there are two types, rotating and reciprocating.

Air that is to pass through the fine pores of a diffuser plate must be free of dust and dirt particles. There are various types of air filters available, but the most important point to be considered is the fact that no matter which type is used, the installation must be made so that any part of it can be removed for repairs or cleaning, and still leave a sufficient capacity for service while the repairs are being made. In other words standby service is essential.

Centrifugal compressors run at extremely high speeds, in some cases over 10,000 r.p.m., and hence require all the extreme care in construction and maintenance that should go with such high speeds. They do not take up as much space as the positive displacement type. The volume of air delivered can be varied within certain limits by opening or closing the blast gate and the air pressure can be varied only by changing the speed of the impeller.

Positive displacement compressors generally run at speeds varying from 500 to 1500 r.p.m. The volume of air delivered varies with the speed and the unit is, therefore, rather inflexible. However, they build up the pressure to overcome any reasonable resistance that may be offered, such as partially clogged diffuser plates. They are invariably larger than centrifugal compressors.

There are two general types of positive displacement compressors; — reciprocating and rotating. The reciprocating type



Dorr Torque thickener

has a moving piston, similar to a steam engine. None of this type is used in the United States. The Hytor compressor has a revolving wheel with blades, similar to a steam-turbine, and is partially filled with water. Its power requirement is greater than that of any other standard type, but it is very quiet and reliable and due to the fact that the machine contains water, the air is thoroughly washed during compression. The Roots-Connersville type of rotary blower has two elements rotating in opposite directions, forcing out the air around them as they turn. It is simple in design and very efficient.

Final Sedimentation Tanks. The final sedimentation tank in an activated sludge plant separates the activated sludge from the treated plant effluent. It may provide storage space for this sludge during periods when it accumulates faster than needed for the inoculation of incoming sewage or faster than it can be disposed of as excess sludge. Two characteristics of activated sludge make it different from ordinary sludges and affect the design of the final settling tank:—(1) Properly aerated sludge settles rapidly and will remain settled for several hours; (2) Activated sludge that is not properly aerated is difficult to settle, and will not remain settled for any length of time; a process of anaerobic decomposition sets in, gases are generated that tend to float the sludge, and most important, it loses the ability to function properly when mixed with the incoming sewage. The sedimentation of activated sludge requires the optimum in quiescent conditions. Eddying and cross-currents should be avoided in designing sedimentation tanks for this purpose. The settled sludge should be removed continuously and with the least possible disturbance to the tank contents. The tank should be deep enough to provide for peak activated sludge storage. Experience with the sedimentation of activated sludge indicates that surface area is also important, and 1600 gallons per square foot per day is probably the highest figure that can be used with safety.

Activated Sludge Return. Non-clogging centrifugal pumps are generally used for removal of activated sludge from the final sedimentation tanks. Such pumps should be selected to provide for the requirements of all raw sewage flow rates as well as for stand-by service at average and minimum flow rates. As previously stated, return activated sludge may vary from 15 to 35 per cent by volume of the incoming raw sewage. For the smaller plants sludge division boxes are available for automatic separation of return sludge and excess sludge.

Flow Meters. Considering the importance of adjusting intensity of aeration, quantity of return sludge, and quantity of excess sludge, and the need of a continuous, accurate and dependable measurement of raw sewage, return sludge, excess sludge and (in an air diffusion plant) volume of air, the desirability of flow measuring apparatus is self evident. Venturi tubes are available as primary measuring devices for the flow of raw sewage and sludge. Orifice plates may be used as a primary measuring device for air. Meter instruments should be of the recording, indicating and totalizing type for obvious reasons.

Test Apparatus and Sewage Samplers. Every successful manufacturing plant keeps accurate records so that a comparison of input and output is possible. The design of every sewage plant should include sufficient laboratory equipment and reagents to conduct all the essential tests that are necessary to obtain a measure of plant performance. For those tests that require composite samples, reliable automatic samplers should be provided. Where Venturi tubes and meters are included in the plant design, the samplers may be arranged in the automatic controls to vary the sampling intervals so that truly representative samples may be composited over each 24 hours. One manufacturer offers an automatic sampler equipped with a refrigeration unit which maintains the composited sample at the temperature recommended in the 1938 edition of Standard Methods of Water and Sewage Analysis, which book should be included as part of the plant laboratory apparatus.

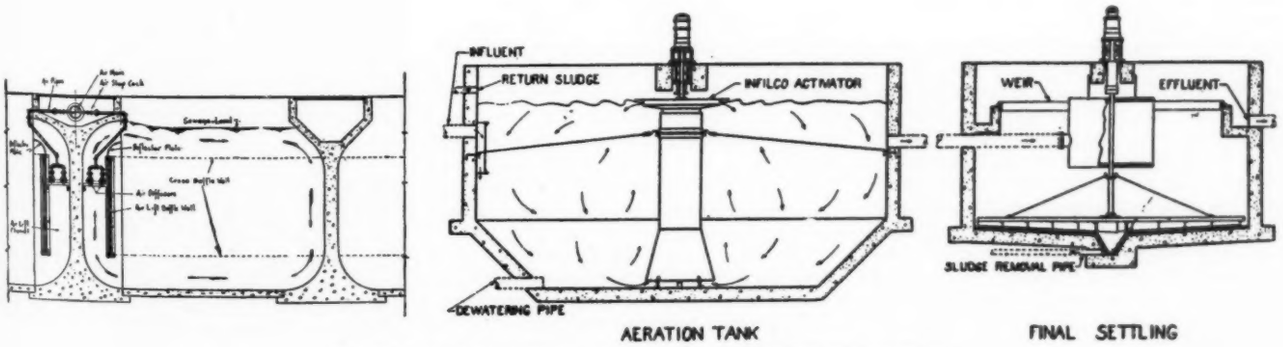
Operation

Primary Sedimentation. The economic soundness of primary settling preceding activated sludge treatment has been well established, especially with the stronger sewages. It not only removes approximately one third of the suspended solids and B.O.D. load, but it provides opportunity for the removal of grease and other ether soluble matter by skimming. This material would have a detrimental effect on the aerobic organisms in the activated sludge floc of the aeration tanks.

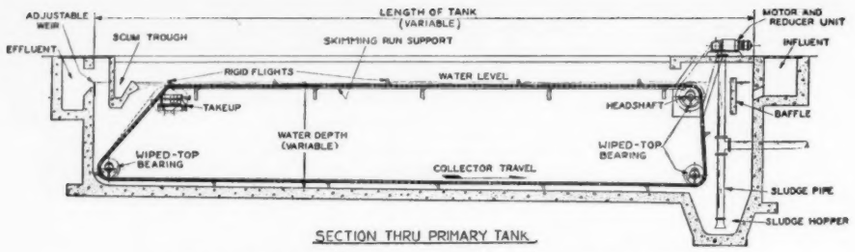
Activated Sludge Return. The amount of activated sludge that must be returned to the incoming sewage depends on the volume and organic contents of the raw sewage and the concentration of the returned sludge. Upon mixing activated sludge and settling the mixture the first result is clarification. The activated floc seems to entangle the solids in the sewage, and draw them to the bottom. This is evidently mere physical action and one might think that the more activated sludge is added to the incoming sewage, the better the treatment would be. But the returned sludge has an oxygen demand of its own, and if more sludge is returned without a corresponding increase of aeration, particularly if this sludge is not properly activated, a good effluent is impossible to obtain. A sewage with a higher organic content requires a larger amount of activated sludge. The more concentrated this sludge, the smaller the volume required, and the lower the pumping cost.

A well-aerated sludge will settle better, can be kept longer in the final clarifiers, and a smaller volume of it need be returned to the incoming sewage. The longer the activated sludge remains in the final clarifiers, the more of its activation it loses, and the greater its oxygen demand when it is returned to the aeration units. To counteract the loss of activation, some plants have a special reaeration tank where the returned sludge receives about an hour of aeration before it is mixed with the incoming sewage. However, a large amount of thin sludge returned to the raw sewage will considerably reduce the aeration pe-

Norton porous plates in bottom of aeration tank



Link Belt spiral flow aerator at left: Infilco mechanical aerator, right.



Typical rectangular tank sludge collector, primary tank

riod that is given to the returned sludge.

Good practice limits the amount of return sludge to sufficient well activated and well concentrated sludge to satisfy the incoming load, and no more. Average demands at San Antonio are satisfied with an activated sludge solids return of about ten times the weight of the solids coming from the primary clarifier. To make this clear, assume a flow from the primary clarifier at the rate of 1.5 mgd having 125 p.p.m. of suspended solids. This would make 1.5 x 8.35 x 125 or 1566 pounds of suspended solids in the aeration tanks per day. If the suspended solids in the returned sludge amount to 4500 p.p.m., then 1566 x 10 x 1,000,000, divided by 4500 x 8.35, or 416,766 gallons per day should be returned. This amounts to about 27.7% of the daily flow, and the amount to be returned, in ordinary practice, is given as from 20 to 35%.

The use of this ratio of 10 will result in a mixed liquor with a greater density as the organic content of the incoming sewage increases, which is as it should be. This necessitates an increase of atmospheric oxygen, and unless the intensity of aeration is increased, plant performance will suffer. The variation of the sludge index (which is to be explained later), is a very good indicator of plant performance. A rising sludge index is a warning of trouble to come which can be avoided if the proper steps are taken immediately.

Aeration. The amount of compressed air needed in a diffused air activated sludge plant has been stated as being from ½ to 1½ cubic feet of air per gallon of sewage treated. The actual amount required depends on the load placed on the plant and on the plant design; a sewage with a high organic content demands more oxygen than a diluted sewage. It also depends upon the degree of treatment necessary and this in turn depends on the method of disposal of the effluent from the plant. A plant effluent flowing into a large river providing ample dilution, need not have as high a degree of treatment as one flowing into a small stream, or one used for irrigation. It also depends on the system of aeration used. Mechanical aeration, combined with diffused air, requires less compressed air than diffused aeration; but the power used for mechanical aeration must be considered when the total cost of operation is estimated. The same holds true for plants using mechanical aeration only. The mechanical aeration plant equipped with aerator units providing the adjustable feature may be operated in such a manner as to conserve operation cost for power by adjusting the required oxygenation to the effluent requirement. But it is not only cost compared to the necessary performance that must be considered. All mechanical equipment must be given the care and attention necessary to keep operating difficulties due to breakdowns at a minimum. It may well be, that a combination of the two systems, that is treatment of the incoming sewage-activated sludge mixture first by diffused air, then by mechanical aeration, may prove to be the most economical method on the basis of pounds of B.O.D. removed per unit of power input.

Experience at San Antonio indicates a need of from 800 to 1000 cubic feet of air per pound of B.O.D. of the primary effluent. This figure of cubic feet of air per pound of B.O.D. load is calculated as follows: Assume a flow of 1.5 mgd, a primary effluent B.O.D. of 120 p.p.m., and the air to the aeration tanks as 1,300,000 cubic feet. Then 1.5 x 8.35 x 120 equals 1503, the B.O.D. load. Next, 1,300,000 divided by 1503 equals 860, the cubic feet of air per pound of B.O.D. that is being used. According to San Antonio experience, this will maintain proper plant performance, but is ordinarily not enough to right a plant that is suffering from a bad case of sludge bulking. By "proper plant performance" is meant here a performance resulting in an effluent containing not more than 20 p.p.m. of either suspended solids or B.O.D.

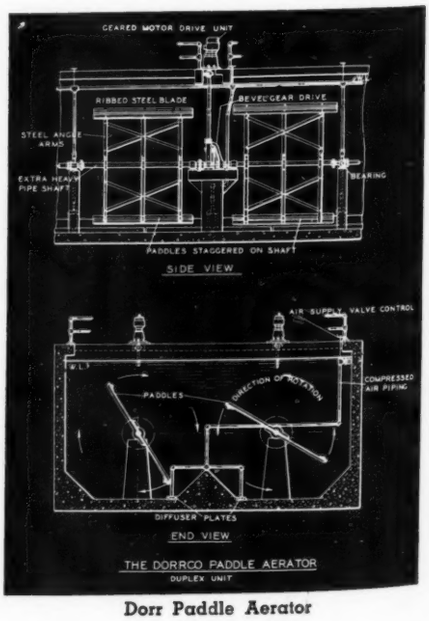
Reaeration. Whether the returned sludge should be aerated before entering the mixing chamber is a debated question. Usually it is omitted: the need depends on the condition of the sludge being returned. If the detention in the final sedimentation tanks is relatively short, the sludge probably loses little of its activation and reaeration may not be necessary. If, however, the detention time is fairly long, reaeration may be of decided value, especially at times when the sludge is under-aerated. At the San Antonio plant, from 5 AM to 10 AM the rate of flow is often as low as 10 mgd giving a detention period of 7.5 hours in the final settling tanks,—more than three times what it should be. From 12 noon to 9 P.M. the rate of flow is about 26 mgd, resulting in a detention period of 2.9 hours, which is not too long. At the rate of 35 mgd the detention time is 2.1 hours which is about what it should be. Where these fluctuations occur in the detention period in the final clarifiers, aeration of returned sludge may be helpful.

Excess Activated Sludge. The amount of excess sludge to be removed amounts usually to from 2 to 3 per cent of the raw sewage flow. The time at which to waste this sludge is governed by the load put on the plant by the incoming sewage. As the flow increases, the amount of activated sludge to be mixed with it must increase and this can be accomplished either by increasing the sludge return or by decreasing the amount wasted. Usually the latter is the simpler method. During times of low flow, when the detention period in the final clarifiers is longer, the activated sludge, if in good condition, will be more concentrated, and, therefore, a wastage in gallons equal to that of a period when the detention time is shorter, results in the wastage of a greater number of pounds of solids.

In some plants this excess activated sludge is returned to the primary settling tanks, to be settled out with the raw sewage solids and to be pumped with them to the digester tanks. This method has never been successful in San Antonio. Coming in contact with the primary sludge, the activated sludge becomes septic and rises to the tank surface. This floating septic material flows into the aeration tanks and puts an excessive load on that portion of the plant.

The excess activated sludge may be disposed of by digestion. Since its volume is large, compared to the volume of primary sludge—possibly 10 to 12 times as much —the digestion space must be proportionately large. The original digestion tank volume at San Antonio was 3,344,000 gallons. This volume, when the excess sludge was pumped into the digesters, had to take care of about 500,000 gallons of primary and excess sludge per day. This resulted in a very heavy supernatant which upset the plant in a short time. According to San Antonio experience, an activated sludge plant conducting its excess activated sludge to digesters, requires a digestion volume based on a design of about 1.9 cubic feet per capita of contributing population. [Ed. Note: More capacity is generally needed in northern areas. Pearse states Chicago needs over 7.5 cu ft.]

With sufficient digestion tank volume available, and under suitable temperature

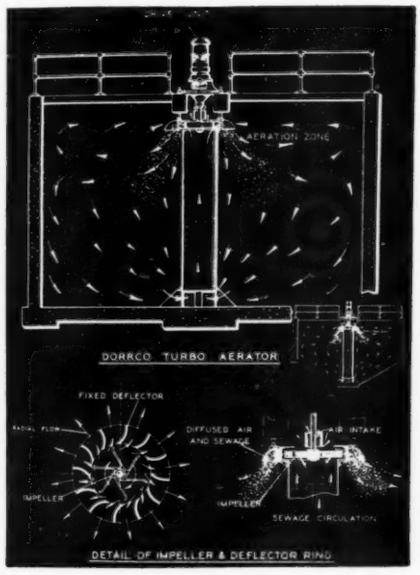


Dorr Paddle Aerator

conditions, activated sludge digests properly without any undue nuisance from foaming or an excessively heavy supernatant. At San Antonio, approximately 450,000 gallons of .4% excess activated sludge and 40,000 gallons of 5% primary sludge go to one set of digesters. The resulting digested sludge rarely has more than 2.5% solids. The capacity of these tanks is 7,429,000 gallons or approximately 15 gallons for each gallon of sludge entering them daily.

Two special tanks receive the supernatant from these tanks whenever it appears necessary to settle excessive suspended solids. As a result the supernatant suspended solids average below 1000 p.p.m.

Excess activated sludge can be thickened somewhat before being pumped to the digesters, according to Goudey and Bennett ("Water Works and Sewerage," 1933, page 179). Kraus and Longley have studied this at Peoria (Sewage Works Journal, January, 1939).



Dorr turbo-aerator

Vacuum filtering and drying is an economical method of disposing of excess sludge at large plants, where the amount involved warrants the capital expenditure. Small plants may dispose of excess sludge in long furrows which are refilled with earth when the water has disappeared. Drying of activated sludge on sand beds is likely to lead to odor nuisance, and at best is applicable only where a small amount need be disposed of daily with a large drying bed area availble.

Control-tests. Only the special tests that are necessary for activated sludge plant control will be considered here.

To estimate the amount of sludge returned to the incoming sewage it is necessary to determine the amount of suspended solids in the primary effluent, in the return sludge, and in the mixed liquor in the aeration tanks. The amount of raw sewage and of the returned sludge must also be known. It has been said that changes in the sludge index are a good indication of plant performance. To determine the sludge index, the volume of sludge in the aeration tank mixture after 30 minutes sedimentation must be determined. This volume in per cent divided by the suspended solids in per cent of the aeration tank mixture (both of these samples should be taken at the end of the aeration tank), gives the sludge index. To make this clear, suppose a liter of aeration mixture settles to 250 cc. in 30 minutes, and the suspended solids of another portion of the same sample show 1600 p.p.m. suspended solids, then 25% divided by 0.16% equals 156, the sludge index. [Ed. Note: The sludge index in a mechanical aeration plant normally ranges from 200 to 300, as compared to 50 to 150 or 200 for diffused air plants.]

The free ammonia in the incoming sewage compared to the free ammonia in the effluent, is another valuable test for plant control. A slight reduction in the ammonia content indicates that nitrification has started. And of course, one should know the amount of solids in the effluent, for an increase in these solids certainly indicates a decline in plant performance.

At San Antonio we consider that the amount of air used in cubic feet per pound of B.O.D. in the primary effluent is much more significant than the cubic feet of air per gallon of sewage. To determine this, the B.O.D. of the primary effluent must be known. It will be appreciated that the B.O.D. of the final effluent should also be determined regularly for a comparison of plant output with plant input.

[Ed. Note: According to *Standard Methods:* The sludge index is a measure of the density of the sludge. A 1-liter sample is collected at the outlet end of the aeration tank, and allowed to settle for 30 minutes in a 1000 ml graduated cylinder and the volume occupied by the sludge is reported in per cent or in milliliters. The sample is then thoroughly mixed, or another similar sample taken at the same time is used, and the suspendid solids determined and reported in per cent or in parts per million.

When readings are in per cents,

$$\frac{\text{Per cent of settling in 30 min.}}{\text{Per cent of suspended solids}} = \text{sludge index}$$

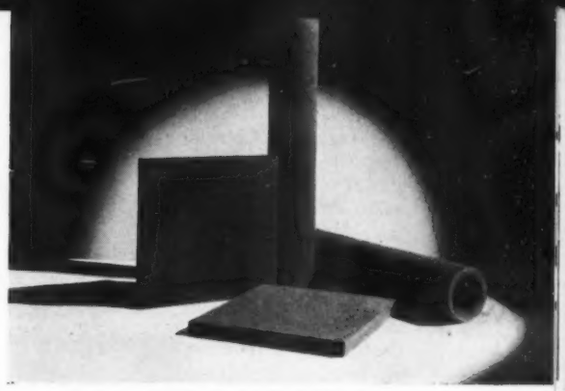
When the readings are millimeters and parts per million,

$$\frac{\text{ml. of settled sludge}}{\text{p.p.m. suspended solids}} \times 1000 = \text{sludge index}$$

[A test may also be made for activated sludge settleability. The value of this test lies in showing the rate at which activated sludge will settle, thereby indicating whether it is in good or bad condition. A liter sample is collected at the outlet end of the aeration tank and placed in a 1000 ml. graduated cylinder. The volume occupied by the settled sludge in 15, 30, 45 and 60 minutes is noted and plotted on a chart.]

Operating Difficulties. All methods of sewage treatment have troubles inherent to that particular method. There are the usual mechanical troubles with pumps and other moving mechanisms. Here will be considered only the difficulties peculiar to the activated sludge process.

Bulking of the activated sludge is by far the most serious trouble and the most difficult to remedy. The success of the activated sludge process is dependent on adequate aeration and proper settling of the sludge floc. If for any reason this fails



Norton porous plates and tubes

to settle properly, the final clarifiers, especially during periods of peak flow, instead of having several feet of clear water above the accumulated sludge, will be filled with thin watery sludge which will flow over the effluent weirs. As the sludge is then very thin, it necessitates the return of a larger quantity of sludge to the incoming sewage, and as it is not properly activated the sludge is unable to function properly. As a greater volume must be mixed with the incoming sewage, the detention time for both reaeration and aeration is consequently reduced.

Many theories as to the cause of sludge-bulking have been advanced, including septic conditions due to under aeration, prolonged holding of the sludge in settling tanks, industrial wastes which contain carbohydrates and overloads of organic matter. At San Antonio we have noticed that whenever the load on the plant increased without a corresponding increase of air, the sludge bulked and it continued bulking until the proper balance between the air and load was re-established. Two causes that have been definitely correlated with bulking, that is bulking that continued over a period of several days, are: An amount of slaughterhouse waste several times the small amount normally received each day, and a heavily laden digester supernatant for a period of several days. Either one of these loads, added to the ordinary load the plant was able to carry with the air used, always caused bulking. However, this bulking could be corrected within a few days by either removing the load, or by increasing the air supply.

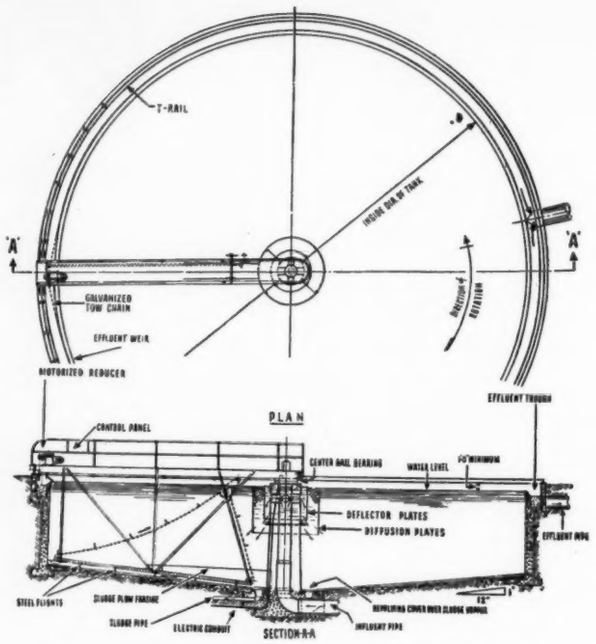
A rising sludge index is a very good warning of approaching bulking. At San Antonio, a sludge index of 200 indicates that the performance is still good; but when it goes above that, danger is close at hand and sludge may go over the final clarifier effluent weirs at any time. As the load on the plant decreases, if the amount of air remains the same, the danger of bulking passes and the sludge index drops.

The worst feature of sludge bulking is that it is a cumulative condition, that is, the poorly activated sludge returned to the raw sewage not only is unable to do the work expected of it but this same sludge puts an additional load on the plant. The result is that if the sludge has been bulking for a number of days before the proper remedial measures are taken, much more air is needed to remedy the condition than would have been needed to prevent it.

Several remedies for sludge bulking have been given in the literature of sew-

age treatment. Chlorine added to the return sludge has been used successfully at Houston; but great care must be used not to overchlorinate and destroy the organisms that are expected to perform the function of reducing the organic content of the raw sewage. Lime and finely divided clay have been added to the mixing chamber. Both of these improve the settleability of the sludge, thus keeping it from going over the weirs, but this is not a remedy of the disease. The cause of the bulking is not removed by this procedure.

Approaching the problem in a logical way, and repeating that which has already been said, these are the principles to be considered: The incoming sewage has a certain biochemical oxygen demand, as has the activated sludge added to it. During ordinary plant performance both these demands are satisfied by the amount of air ordinarily used. If the demand of the incoming sewage increases, either through increased flow or through the addition of an increased amount of industrial waste, proper plant control requires not only an increase of returned sludge but also an increase in the amount of air supplied to take care of both the increased sewage load and the increased sludge return load. Unless this procedure is followed, the sludge will soon bulk and the return of this bulking sludge will further increase the oxygen demand of the sewage sludge mixture. If the air supply cannot be increased, it would be better to reduce the amount of sludge returned and have a poor effluent rather than a bulking sludge, until the increased load is reduced. Once the sludge is bulking, the best thing to do if the air supply is limited, is to waste as much sludge as possible, thereby reducing the solids carried in the aeration tanks, and then develop a new properly activated sludge.



Plan and section of "Circuline" collector [Link-Belt Co.]

Cost of Construction and Operation

The cost of construction of any type of sewage treatment plant depends on local factors and the degree of treatment desired. The same, naturally, is true of cost of operation. Fischer of the Dorr Co. ("Sewage Works Journal," March 1936,) gives the cost of construction of an activated sludge plant, having primary sedimentation, aeration and sludge digestion, at from $40,000 to $110,000 per million gallons daily. The cost of operation of such a plant he sets at from $10.00 to $27.00 per million gallons. If vacuum filtration of the digested primary sludge and raw activated sludge is added to this, the cost of construction is greater and the cost of operation is increased an additional $4.80 to $11.50 per million gallons. If all sludges are first digested and then filtered, the construction cost is further increased and the cost of operation raised by from $6.30 to $8.50 per million gallons.

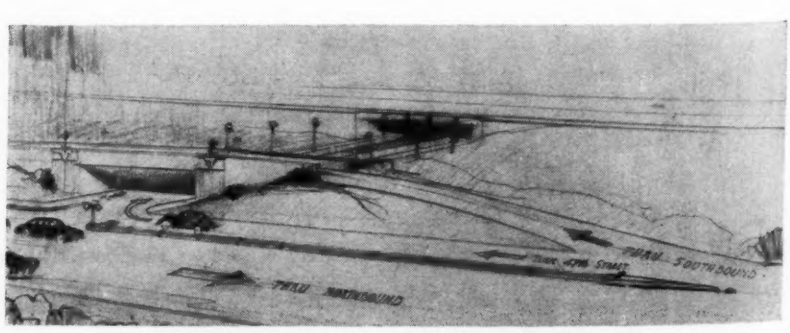
The wide variation of these figures indicates that local conditions greatly influence costs of construction and of operation.

Similarly, local conditions should determine whether or not the activated sludge process is to be adopted. Cost, of course, is one of the conditions. The special advantages of the activated sludge process may be enumerated as follows: (1) No other process can attain as high a degree of treatment (but often this is correspondingly expensive from an operation standpoint); (2) the process is practically free from odors; (3) Less area is required than for any other type of plant with the possible exception of chemical treatment.

Opposing these advantages are (1) the often high operation cost of treatment as compared to other biological treatment processes; (2) the necessity of constant skilled supervision; and (3) the fact that the process is highly sensitive to variations in organic content of the sewage to be treated. An added disadvantage may be considered to be the relatively large volume of high-water-content excess activated sludge which requires increased digestion tank volume, if the digestion process is used, and greater sludge drying bed area, if air drying is employed. The use of vacuum filtration and artificial drying removes this obstacle and tends to provide an activated sludge plant that is compact in appearance and practically odorless in operation.

A Safety Fin and Deathless Safety Island

THE Chicago Park District is completing the construction of a new type of divisional fin on the Outer Drive at 47th Street. It features two new types of safety islands. The north island has approaches of white concrete and is so designed that cars are deflected from the island proper if stuck from an angle or off center, or stopped by friction and gravity in case the island approach is straddled. The south island approaches are of two parallel inclined wire cables with yellow boards between these cables. Cars whose drivers are asleep or inattentive would, upon hitting the device, cause the cables to sag and the boards to clack on the pavement, giving a sound warning. Between these islands and two turn-off islands at 47th Street are six separate strands of yielding cable, arranged to act as a positive divisional fin without the dangers of the fixed types of curbs ordinarily used. Cars striking this would be deflected back to the proper channel by the yielding cable and would not jump the curb.



New Safety Construction in the Chicago Park District

Charges for Water Service Outside the City Limits

MUNICIPALITIES generally cannot levy a tax or special assessment on residents beyond the corporate limits but if water service is desired the city can require subdividers to install utility services and make special agreements for payments by individuals for the cost of installing water extension pipes outside the city. A wide variety of methods is used in financing the cost of water extensions outside the city limits. For example, in Pueblo, Colorado, the estimated revenue must justify the water department expense in building the extension. Pasadena, California, assesses property for the cost of a six-inch cast iron main. In Phoenix, Arizona, outside extensions are financed by the consumer or by the real estate subdivider; and in Atlanta, Georgia, such extensions are paid for by the property benefited. In Durham, Raleigh, and Winston-Salem, North Carolina, water mains are constructed for the city at the expense of the water users; in Durham the mains are deeded to the city as soon as built, and in the other two cities they become the property of the city when the territory is annexed. Columbus, Georgia, requires consumers outside the city to pay for the cost of constructing the water mains and deed them to the city. Nashville, Tennessee, does not build mains outside the city but requires that the mains must be laid in accordance with the regulations of the water department.

Most municipal water departments, as revealed by a recent survey by the American Water Works Association, charge a higher rate for water sold to retail consumers outside the city limits than within the city. The rates outside the city vary from a small percentage to 100 per cent higher than within the city, with many cities charging about 50 per cent more. In a few states, such as Illinois, Ohio, Mississippi, and Wisconsin, state laws determine the rate charged by municipal waterworks to consumers outside the city. An Ohio law permits municipal and private waterworks to charge 10 per cent more than city rates, plus the cost of mains laid outside the city limits, and a Mississippi law permits a 25 per cent increase. In general, however, state utility commissions have no authority over rates charged by municipal waterworks, and cities are free to establish rates for consumers outside their limits.

Municipal officials generally agree that out-of-town consumers should pay a share of the capital cost of the system, as well as the expense of delivering the water used. One authority has suggested that the basis of the charge should be the total cost of water service, including the average cost per foot for the distribution system as a whole, and that the outside consumer be required to pay in one sum or a series of time payments an amount equal to the capitalized charges made for construction costs. In addition the consumer would pay the regular water rate charged within the city and any extra burden which the city wishes to impose upon non-residents would be added in the form of a percentage either of the initial charge or the water rate or both. Cities that levy and collect taxes for water system purposes can justifiably charge a higher rate than cities which do not tax for this purpose. Many municipalities must pay property taxes on water supply equipment outside their corporate limits. Some cities, such as New York and Chicago, sell water at fairly low rates to smaller nearby governmental units which in turn sell water to their citizens.

Some cities charge the same rates for commercial and industrial supplies, but charge higher rates for resi-

dential service. The water rates charged consumers outside the city limits are double the rates inside the city in Joliet, Illinois; Augusta and Atlanta, Georgia; Anaheim, California; Durham and Winston-Salem, North Carolina; and Nashville, Tennessee. The rates are 50 per cent higher to outside consumers in Tucson, Arizona; Knoxville, Tennessee; and Syracuse, New York; 25 per cent higher in Colorado Springs, Colorado; Battle Creek and Bay City, Michigan; Marion, Indiana; and Sioux Falls, South Dakota; and 10 to 20 per cent higher in Elmira, New York; Eugene, Oregon; Zanesville, Ohio; and Hagerstown, Maryland. The higher rates charged to consumers outside the city generally apply not only to minimum rates but also to additional charges for usage. In addition, some cities as Holland, Michigan, require a deposit to guarantee the payment of water bills. Other cities set a total minimum rate for nonresidents, which in the case of Lockport, New York, is $25 a year, the rate being 50 cents per 1,000 gallons. A few cities, as Hagerstown, Maryland, require signed agreements from all property owners outside the city limits served by the city water supply to guarantee a return of 10 per cent on the investment in water extension pipes. Los Angeles, in addition to charging higher rates, provides water service outside the city limits only where the property is contiguous to the city and mains already exist, or where trunk lines feeding other parts of the city cross county territory, or where the city has acquired water lines—in which case 80 cents per front foot street main assessment charge plus the service connection charge must be paid.—*From "Public Management."*

Fundamental Principles in the Selection of Recreation Areas

1. The objective in furnishing municipal recreation facilities is to enable all groups of the population in all sections of the community to enjoy wholesome recreation from day to day throughout the years at reasonable cost.
2. The age groups to be served are:
   (a) Children under six years of age.
   (10 per cent of the population)
   (b) Children six to 14 years of age, inclusive.
   (15 per cent of the population)
   (c) Children and youths 15 to 25 years of age, inclusive.
   (20 per cent of the population)
   (d) Adults over 25 years of age.
   (55 per cent of the population)
3. The chief types of areas needed are:
   (a) Little Children's playgrounds.
   (To be located principally within other recreation areas)
   (b) Children's playgrounds.
   (Serving one-half mile radius and located at elementary schools where practicable)
   (c) Playfield.
   (Serving one mile radius and located at junior and senior high schools and in neighborhood parks where practicable)
   (d) Neighborhood parks.
   (Serving one-half mile radius and including schools and playfields where practicable)
   (e) Large parks, reservations, pleasure drives and special areas.
   (Largely the responsibility of the state and counties)
4. Recreation areas should be properly correlated with other elements of a comprehensive city or village plan such as major streets, rail and transit facilities, schools, and zoning districts.
5. A well balanced system of recreation facilities to meet both present and future needs should be carefully planned before any extensive individual developments are undertaken. Balance of the various types of facilities and their distribution in relation to population, rather than total acreage, determine whether or not a community is well served.
6. Recreation facilities should be located as close as practicable to centers of areas to be served. Few children and an almost insignificant number of adults will walk more than one-half mile to a park or playground; therefore, intensity of use depends largely upon proximity and easy accessibility.—*The Municipality.*

Sewage Treatment Investigations at Chicago

(Continued from page 11)

deep. Mixing is accomplished by means of diffused air. Following the mixing tanks are two flocculation tanks which are operated in parallel. Each tank is 30 ft. long by 17.5 ft. wide with a water depth of 8 feet, equipped with Dorr flocculation apparatus. The two tanks provide a flocculation period of 30 minutes with a one-hour period in the settling tank.

The settling tanks were formed by building a dividing wall in one of the Imhoff tanks of the West Side Works. Each tank provides a detention period of one hour with a flow of 2.83 m.g.d. Flow through the tanks may be reversed. The digested sludge is pumped to one of the sludge drying beds.

The magnetite filters are each 120 feet long and 5 feet wide, with a sand depth of 3 inches. A portion of the settled effluents can be bypassed to the drain ahead of the filters so that the filtering rate may be varied.

The plant was placed in service September 7, 1937. The chemicals used and the approximate range in dosage (expressed in pounds per million gallons) thus far have been as follows:

Ferric chloride (130-160 lb.) and lime (190-310 lb. as CaO).

Ferric chloride (110 to 200 lb.).

Clorinated copperas (330-420 lb.).

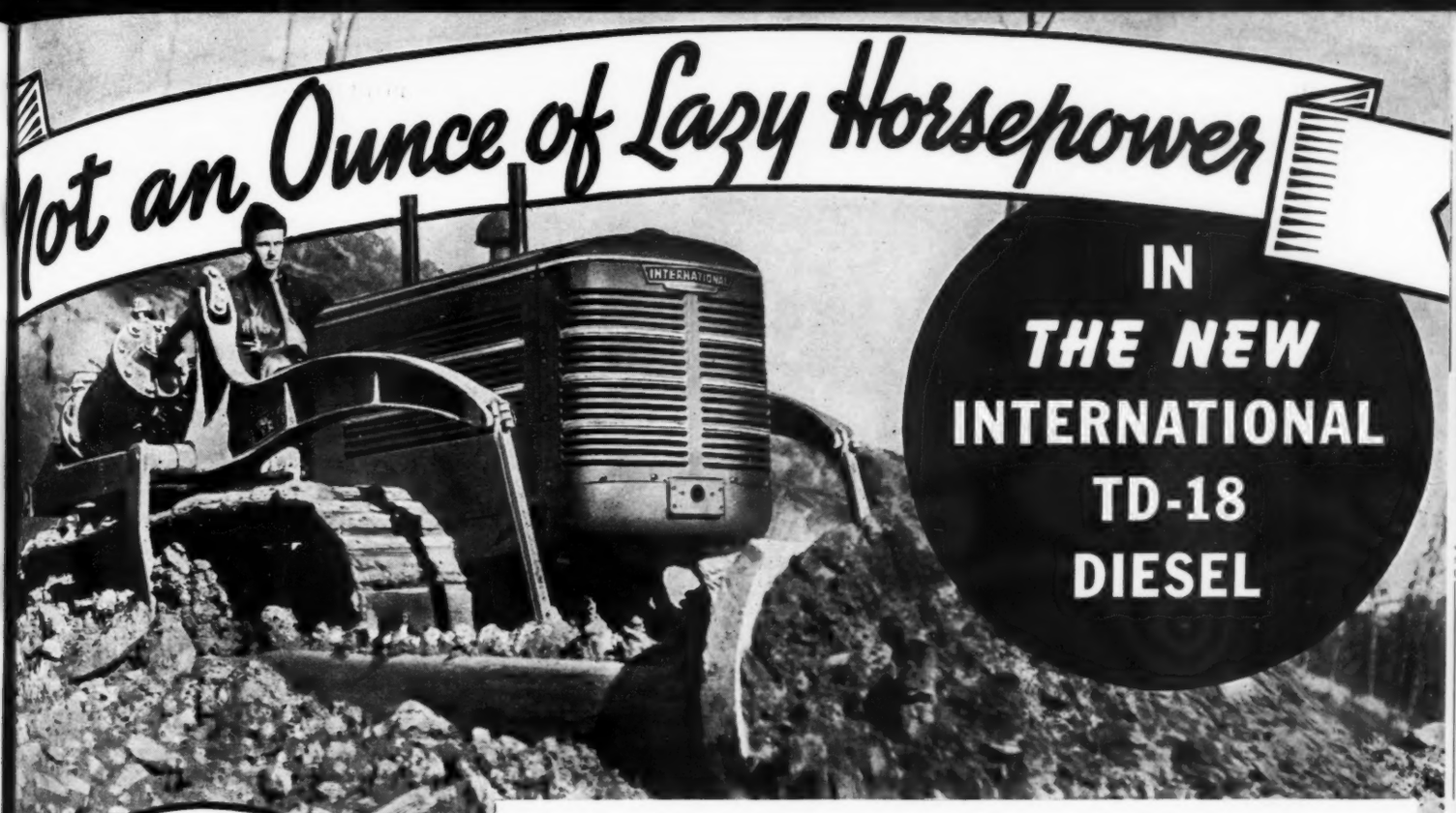
Copperas (100-230 lb. Fe $SO_4 7H_2O$) and 42°Be' Sodium Silicate (105-120.).

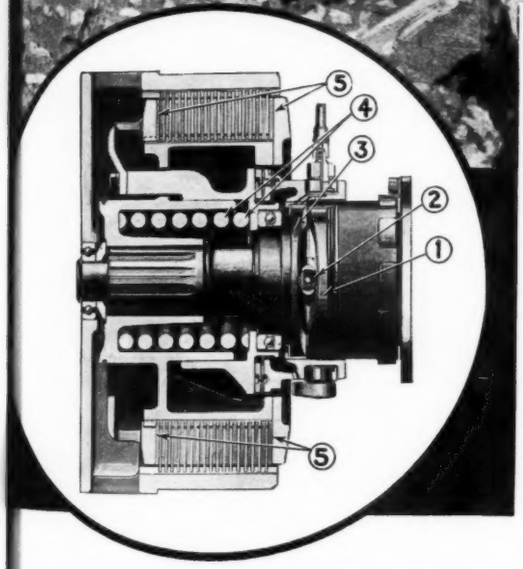
In addition, waste pickling liquor from a steel mill was used with sodium silicate for a 30-day period. Due to free sulphuric acid in the liquor it was necessary to adjust the pH by the use of lime. In 1938 tests were made to determine the effect of bypassing either the mixing tank or the flocculator or both units.

The settling periods have varied from one to two hours. The magnetite filters have operated at rates varying from 2.0 to 3.2 gallons per square foot per minute.

Late in 1937 the experimental activated sludge unit was placed in operation. The unit consists of two wooden aeration tanks, a wooden settling tank equipped with sludge removal equipment, a blower for supplying air, two return sludge pumps and metering and sampling equipment. Each aeration tank is 12 ft. wide by 12 ft. deep inside and 24 ft. long overall. They are operated in series. The tanks are made of 3-in. fir, with transverse and longitudinal rods through the tank. Air is supplied through 12-in. square diffuser plates located along one side of each tank. The depth of liquid over

Not an Ounce of Lazy Horsepower IN THE NEW INTERNATIONAL TD-18 DIESEL





FINGER-TIP PRESSURE releases the multiple-disc steering clutches in the TD-18 . . . the engine, not the operator, does the work through power-release actuators built into the clutches. The cross-section view, above, shows how they work. Only enough pressure is needed on the clutch lever to move a friction surface against the rotating clutch hub. Cam (3) rotates about a quarter turn on rollers (2), which separate cams (1) and (3). Cam (3) compresses main clutch spring (4) and releases clutch plates (5).

The power-release actuators relieve the operator of the hard pull ordinarily required to operate slow-speed, multiple-disc steering clutches—saving his strength and reducing fatigue. In addition, the clutches are *fully* engaged or disengaged—no drag on the discs, no unnecessary wear and heating. Brake assistance is seldom required when there is a load on the drawbar.

A NEW DAY is here for users of heavy-duty mobile power! The new 70 h.p. International TD-18 Diesel TracTracTor brings a new standard of operating performance and economy into the picture . . . more work, lower costs, bigger profits.

The power and flexibility of the International 6-cylinder *full* Diesel engine are coordinated to a fine point with other features in the TD-18 . . . *a higher percentage of the maximum drawbar horsepower*—70 h.p.—*can be kept continuously applied to get more work done per day at lower cost.*

The engine starts easily and quickly from the operator's seat . . . no time lost by man or machine in getting on the job.

The TD-18 is the easiest steering crawler tractor built. Engine power, not manpower, releases the steering clutches through power-release actuators built into the clutches.

Six forward and two reverse speeds provide close selection of traveling speed to load without loss in engine r.p.m. or maximum horsepower capacity. Automatic clutch brake facilitates fast shifting of gears.

These features enable the operator to take full advantage of the power available . . . and make the TD-18 *unusually easy to handle* and *easy on the operator.*

Find out what the TD-18 offers for your jobs. The nearby International industrial power dealer or Company-owned branch will give you full details. Remember that there are five other TracTracTors in the International line, also five wheel-type tractors, and eleven power units.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 North Michigan Avenue Chicago, Illinois

These Features Mean Efficiency, Low Cost, Long Life

1. Six-cylinder full Diesel engine.
2. Engine is started easily from the operator's seat.
3. Six forward and two reverse speeds.
4. Automatic clutch brake for fast gear shifting.
5. Easiest steering crawler tractor built. Power-actuated steering clutches.
6. Steering levers and pedals adjustable to suit operator.
7. Pivot shaft relieved of twisting stresses, and tracks kept in alignment, by ball-and-socket outer pivots, diagonal-arm inner pivot bearings, and roller stabilizer.
8. Track shoes keyed to track links to prevent loosening of shoes.
9. Triple-gear oil pump. Full-pressure engine lubrication at all working angles.
10. Positive track roller lubrication at all speeds. Quintuple-sealed track rollers have patented gravity lubrication at low speeds and pressure lubrication at high speeds. Oil and dirt seals on both sides of sprockets. Self-cleaning idler wheel.
11. Tocco-hardened crankshaft with replaceable main and connecting rod bearings.
12. Unit construction. Each steering brake, steering clutch, track frame assembly, and other units, adjusted or replaced without disturbing adjacent parts.
13. Famous TracTracTor accessibility. More productive hours, low maintenance cost.
14. Allied equipment engineered for the TD-18 by well-known manufacturers.

INTERNATIONAL INDUSTRIAL POWER

the plates is 10 ft.

The settling tank is 24 ft. outside diameter (22 ft. 6½ in. inside) with a water depth of 10 ft. at the side. The bottom slopes 1 in. per foot toward the center. The effluent trough 8 in. wide and 10 in. deep is located around the inside periphery of the tank. Influent is admitted through an 8-in. pipe located at the center of the tank. A cross at the upper end of this pipe discharges the mixed liquor just below the surface. Supported between the upper flange of the cross and the steel work over the top of the tank is a 4½-in. steel shaft on which rotates a spur gear with 50.67-in. pitch diameter. Hanging from the gear is a spiral riveted steel pipe 5 ft. 8 in. long and 36-in. diameter. The lower end of the pipe supports a light steel framework on which are mounted the plows for sweeping the tank bottom. The large spur gear is driven by a ½-horsepower motor through a spur pinion, bevel gear and pinion and two speed reducers at a speed of 1 revolution in 10 minutes.

Records and sampling were started January 10, 1938. Treating Imhoff-tank effluent the unit has been operated with aeration periods of 2.0 hr., 1.5 hr. and 1.25 hours. The corresponding settling rates have been 1,114, 1,620, and 1,859 gallons per square foot per day.

A small rapid sand filter was operated from May to November, treating the effluent from the settling tank of the single-stage, high-rate filter. The filter was contained in a wooden tank 6 ft. outside diameter and 5 ft. 6 in. deep. The strainer system consisted of a 4-in. header with 1-in. laterals spaced 6 in. center to center. Holes one-quarter inch in diameter on 2½-in. centers were drilled in the under side of the laterals. Crushed stone was provided to a height of 12 inches above the center of strainer system. The lower 3 inches was ½ inch to 1-inch in size, the next 3 inches ¼ inch to ½ inch, and the remaining 6 inches was ⅛ in. to ¼ in. On top of the stone was 6 inches of sand with an effective size of 0.62 mm. and a uniformity coefficient of 1.34. The wash-water trough spanned the tank on one diameter. The trough was 6 inches wide, with its edge 36 inches above the sand surface. Wash water was pumped by a centrifugal pump into the plant drain. Two wash-water storage tanks with a combined capacity of 2,400 gallons were provided. These were filled with filtered effluent immediately after each washing.

The unit was operated at rates of 2.0 and 3.0 gallons per square foot per minute.

Late in the year chemical solution and dosing apparatus was installed for making tests on the Guggenheim bio-chemical process in the activated sludge unit. Operation is proposed with a one-hour aeration period and a settling period of 1.5 hours. Ferric iron will be used as a precipitant and sludge will be returned as in the activated sludge process.

At the Calumet Sewage Treatment Works tests were continued on the use of waste pickling liquor as a coagulant for waste sludge prior to filtration, at first in the laboratory using filter leaves and later using a 1 ft. by 1 ft. Oliver vacuum filter. Following promising results on the vacuum filter, a run was made using one of the large vacuum filters in the sludge disposal plant. In this test 600 gallons of waste pickling liquor were secured from one of the steel mills, and part of the free acid in the liquor was neutralized with baled iron wire. Chlorine was passed through the liquor by alundum tubes until all iron was oxidized to the ferrous state. With this material as a conditioner, a 3-hour filter run was obtained. To permit better study of the economics of the procedure, equipment was later installed for continuous production of this material utilizing two large

rubber-lined tanks from the West Side Treatment Works.

Other tests were made at the Calumet Works on special steels in sludge fuel lines, on sleeves of various metals in the flash dryers, on the use of Gunite as a lining in the cyclones and on methods of cleaning reheater plates.

In the main laboratory a number of chemists made a study of the fertilizer value, from a chemical standpoint, of sludges from the several works. Analyses were made of samples of dried sludge from the Calumet incinerator and other sludges. The bacteriological content of raw and dried sludge from Calumet was investigated. The reduction of the B. coli amounted to 99.99 per cent and more. Thus the drying process practically eliminates any possibility of pathogenic organisms in the dried sludge.

The possibilities of increasing the nitrogen content of the dried sludge, for use as fertilizer, were investigated. The value of such procedure is doubtful, particularly as the cost appears greater than the increase in value of the product.

Grinding the screenings and return of the ground material to the plant influent at the North Side Works has proved to be a satisfactory method of disposal. New grinding and conveying equipment should be purchased and installed in 1939.

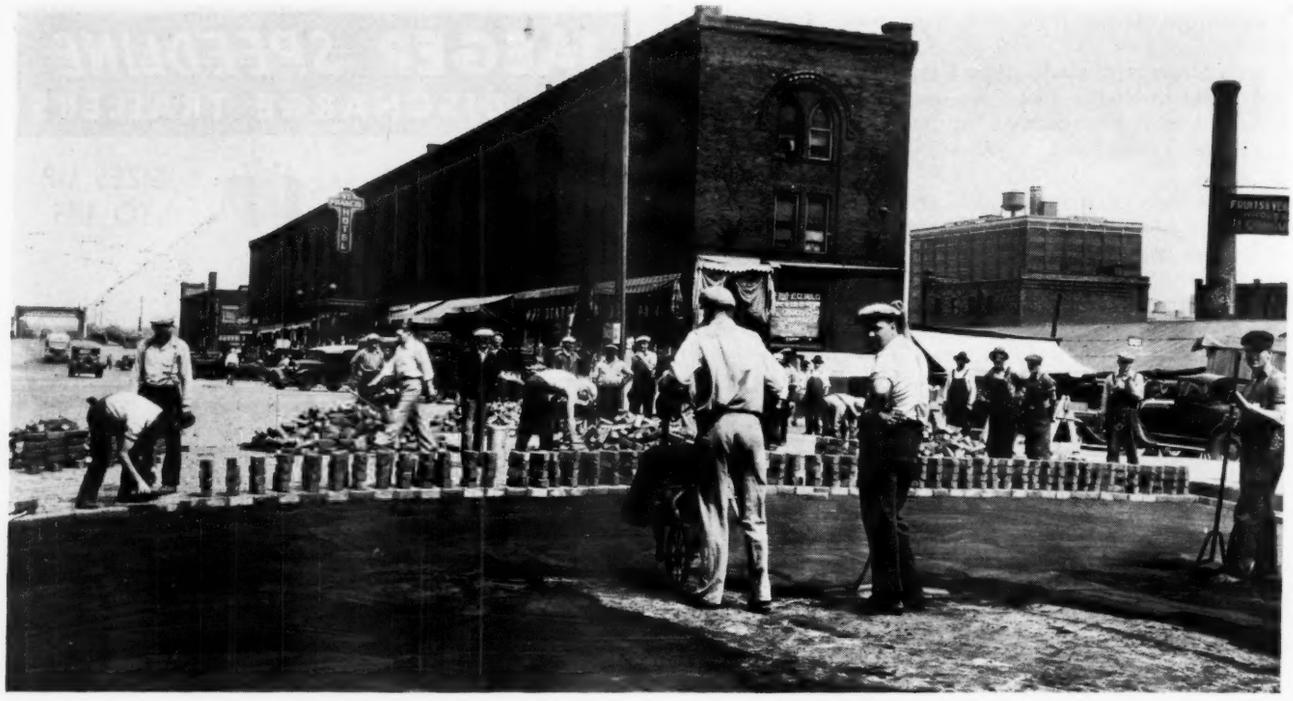
In the aeration system at the Calumet Works the clogging of diffuser plates, due to the waste pickling liquor in the sewage, continued but at a slower rate than in the two previous years. The concentration of iron in the raw sewage and return sludge was greatly reduced through the cooperation of the steel industries which produce these wastes. During 1938 practically all of such wastes were discharged directly to the Calumet river or to the Calumet-Sag Channel. The November shut-down of the works afforded a needed opportunity to replace clogged diffuser plates and recondition others by cleaning with acid. This work will be continued in the Spring until all diffuser plates have been replaced or cleaned. If further clogging does not occur the pressure drop in the distribution system of the aeration tank should not exceed one-half pound, since the iron content of the sewage is reduced.

In September an experimental air lift was installed to replace a sludge pump serving the vacuum filters. The results were so good that the installation is now being made permanent with two air lifts, each having sufficient capacity to supply two vacuum filters. They discharge into a rubber-lined head tank where the conditioning agent will be added and will mix with the sludge as it cascades over a series of weirs before discharge direct to the filters or, when necessary, to the mixing tank. These air lifts provide a uniform flow of sludge to the filters with negligible maintenance.

The above information is from the report of William H. Trinkaus, chief engineer of the Sanitary District, who has an engineering staff of sixteen engineers and an architect.

Lowering Water Main Under Pressure

The article appearing under this head in our June issue was abstracted from one which was written by A. E. Williamson, county sanitarian, and appearing in "Drippings from the Georgia Faucet," the bimonthly publication of the Georgia Department of Public Health. Through an oversight we omitted to give credit for the source of the information.



Relaying 4" brick in Minneapolis; brick originally laid in 1901; bituminous asphalt filter cushion.

How to Maintain Highways and Streets

Maintenance of Brick Pavements

This is the seventh installment. Another, covering maintenance of stabilized surfaces will appear in the August issue; and others from time to time thereafter.

Construction Methods.—Essential features for brick pavement are (1) a concrete or other firm base in order to assure continued smoothness of the surface under traffic; (2) a cushion or bedding course to care for slight irregularities in the base or in the block sizes; (3) a filler for the joints between the courses of brick. The base is usually a lean-mix concrete, without reinforcing or expansion joints, the depth depending on the subgrade conditions and the weight of traffic that the road is expected to carry. The bedding or cushion course may be of sand and cement, or a bituminous-mastic course, using tar or cutback asphalt and a well-graded aggregate. This course is spread on the base to the desired cross-section and crown by means of templets, and the brick laid, usually by hand, on it, with the joints staggered. On some recent jobs, the brick have been laid longitudinally

After placing the brick, they are rolled with a 3 to 5-ton roller, and broken or imperfect brick removed and replaced. The joints are then filled; generally a bituminous filler is used. To prevent this from sticking to the brick, the surface of the brick is sprayed with a "mist" or "fog" coat of calcium chloride solution, whitewash, sodium silicate or similar material. The heated filler is then poured on the surface and squeegeed into the joints. When the surface of the brick is below 50°F, it should be heated before applying the bituminous filler. Application is usually from buckets or grout carts. After cooling, the excess filler is peeled off with spades or sidewalk cleaners.

Considerations in Maintenance.—When planning maintenance, the conditions of the pavement should be considered. Perry classifies brick pavements as (1) those that are in such conditions that they are suitable for maintenance as brick pavements, and (2) those that must be relaid, salvaged or replaced. The probable cost of repairs as compared to the value of the pavement when repaired will govern the procedure. Those pavements in the first class are worth more expensive and careful and permanent maintenance operations than those in the second group.

Base Failures.—Many of the old brick-pavements were laid direct on the subgrade, with nothing more than rolling and the placing of a cushion course. Where failure of the pavement is due to settlement of such a rolled base, the brick and the cushion should be removed and the low places leveled up with material similar to the original base. If this is not available or suitable, lean concrete or a lean bituminous cold mixture may be used. If failure is due to inadequate drainage, proper drainage should be installed to remove subsurface water. After the base has been repaired and a new cushion placed, the original brick, if in good condition, may be reused supplemented by such new brick as may be needed.

Where a concrete base has failed, remove the brick over the depressed or broken area, and take out the entire failed portion of the base, noting the most probable reasons that caused the failure of the

base. If possible, the reasons for failure should be removed or corrected. The base should then be repaired, following the general procedure already given for patches in bases. High-early-strength cement is recommended for making patches, as it allows much quicker replacement of the surface, and earlier use of the roadway.

After the base has been repaired, the cushion should be replaced and the brick laid. It is preferable to use the same type and thickness of cushion as was used originally; also the same type of joint filler should be employed.

In case new brick are needed to supplement those that were taken up, the old brick should be matched as closely as possible in color and type. A good man can relay a patch so that after a day or two it can scarcely be noticed. This is desirable from the viewpoint of appearance.

Blowups. — Where blow-ups occur, this is generally due to lack of expansion space in the base; the bituminous filler between the brick afford ample expansion space. In case of a blow-up, the brick and the cushion should be removed, and a transverse or cross-the-road bituminous or other joint constructed in the base to permit expansion. This must be perpendicular to the surface and at exact right angles to the road. Otherwise, expansion may, in the first case, cause one slab of the pavement to climb on the other; and in the second case, permit the whole base to be pushed sideways, causing a crack in the surface.

The Cushion. — Uneven surfaces, especially in old types of brick pavements, are often due to the shifting, settling or falling through a base crack of the cushion course. This is remedied by removing the brick, noting the cause of trouble, correcting this, if due to anything else than cushion defect; adjusting or replacing the cushion; and relaying the brick. The cushion, when replaced, should be carefully spread and well tamped. If the base is markedly uneven, it should be brought to about the correct grade with bituminous mastic, which is also excellent cushion material.

The Filler.—Cement grout filler was formerly used, but in recent years, bituminous filler has been used almost universally.

In repairing a brick pavement, it is desirable from the viewpoint of appearance to use the same filler as was used in the original construction. When the original filler was grout, patches and replacements should be filled with a lean grout filler, using about one part of cement to three parts of sand, and mixing carefully.

Especially in hot weather, prompt repairs are desirable for grout filled brick pavements, since expansion may cause longitudinal cracks. Ohio recommends that short full-width repairs be made with heavy asphalt or emulsion filler, but that lean grout, as recommended above, be used on long section, with a short section of bituminous filler. When using grout filler, it is extremely important that the grout penetrate the full depth of the brick, since surface failure may occur if the cracks are only partly filled.

Surface removal of filler

When bituminous filler is used, small patches may be filled with a pouring pot, care being taken not to permit the filler to spread over the surface. Larger patches should be filled as in original construction, spraying the surface with calcium chloride or whitewash, squeegeeing and taking off the excess.

Filling Cracks. — Cracks sometimes occur in the surface of brick pavements, usually being due to or indicative of cracks in the base. These should be filled to prevent the entrance of moisture to the cushion under the brick, which usually results in heaving or other damage. The width of the cracks will usually determine the method of filling. Small cracks may be filled with a rather dry sand-asphalt or tar mixture; larger ones by applying bituminous filler and brooming grit into the cracks. The surface should be treated to

Cleaning old brick preparatory to relaying

prevent adhesion of the bituminous material, and afterward the excess material should be peeled off.

Relaying Brick. — In patching work, the old brick, with such new ones as are needed, are replaced in the pavement, care being taken to have the patch smooth and similar in appearance to the original pavement.

Old brick pavements after many years of service can be taken up and relaid to give a new and smooth surface. The old base, if suitable, may be used, or the old brick may be laid on a new base. Generally, the old brick were laid on edge; when relaid, they are most often laid flat, thus there is an increase in surface area.

In relaying old brick, the same general procedure is adopted as in constructing new brick; a base is constructed, the cushion placed and the brick laid and filled. A large proportion of the old brick can be reused; shortage is made up with new brick which should match the old in size, color and general appearance.

When some of the brick are badly worn, as those near the center of the old road, poor results will be obtained by trying to lay these on a sand cushion of varying depth. Such a surface will quickly become rough under traffic. It is desirable to sort the old bricks in groups or piles on the basis of their thickness or depth. Then when they are relaid, a uniform surface will result.

Temporary Patching.—Holes that occur should be patched promptly. If delay is necessary before the old brick can be taken up and relaid, the hole should be filled with bituminous cold patch material. Such procedure should be limited to repairs that must be made immediately; and proper patching should follow as soon as possible. The appearance of black spots on the surface mars the appearance of a street or road. The patch should approximate in thickness the depth of the brick.

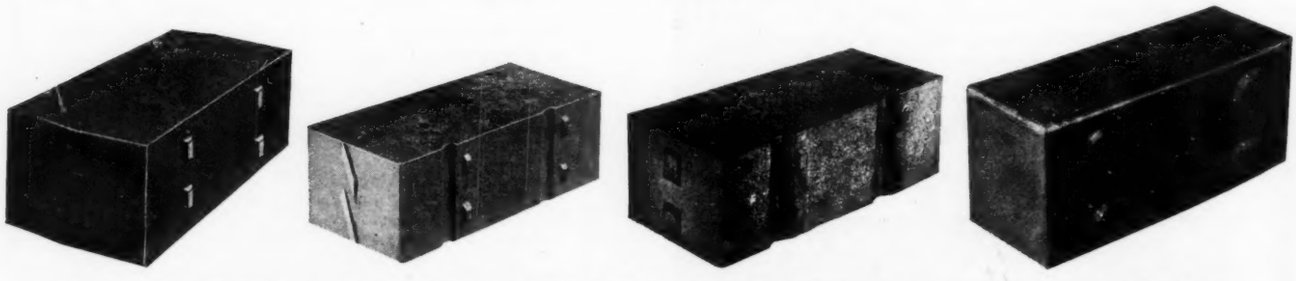
Where sections have failed over a considerable area, temporary repairs may be made by removing the brick from the area, and replacing with a gravel or broken stone surface covered with a bituminous carpet treatment.

Patching with Brick.—The old brick, as removed from the area to be patched, should be cleaned and piled to one side, and apart from any new brick. New brick to be used should be, as already stated, as nearly a match in color and size as is possible; if exact size cannot be matched, a size slightly smaller may be used, but the depth should be the same. In replacing the brick, these should be carefully dovetailed into the existing surface. The straight edge should be used to assure a smooth surface. The brick should be placed just sufficiently high on the cushion so that they will roll to the proper depth, and if high or low spots develop in rolling, these should be corrected. The patch will not settle under traffic if properly made, and therefore should not be left higher than the adjoining surface.

Surface or Other Treatments.—It does not generally pay to give surface or other treatment to brick pavements unless these have deteriorated to such an extent that they are past economical salvaging and are of use only as base. When it has been decided to apply such a treatment, however, the old surface should be patched, loose brick removed, the surface trued up with pre-mix bituminous material, graded to proper cross-section, rolled and allowed to withstand traffic for a time. The wearing course may be a hot-mix heavy surface treatment. "Sweating" brick may break the bond at a light treatment, according to Conzelman, who recommends a standard thickness high type surface for best final economy.

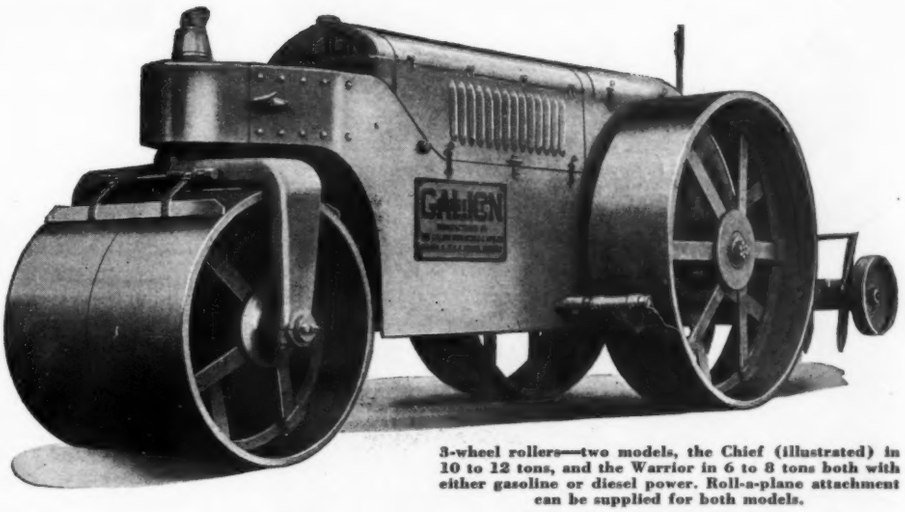
Removing Excess Filler. — An excess of bituminous filler may render a brick surface slippery. Procedure is described in the Ohio Field & Office Manual by Perry, as follows: In removal, satisfactory results will be accomplished with disc planers, blade machines or chisel-tooth planers, these outfits serving best in cold weather. A very light application of kerosene or calcium chloride may help in this operation. The use of surface heaters is effective, but must be preceded by a light application of coarse sand to prevent boiling of the filler, and should be followed immediately with a squeegee. Very satisfactory results and perhaps the most economical have been obtained by surface burning, which is best accomplished by an application of about one ton per mile of sawdust, impregnated with one-tenth to one-fifth gallon per square yard of kerosene (10% gasoline), and ignited over small areas. Straight hoes must follow the fire as quickly as possible, pushing the excess melted filler off the pavement. Prompt application of coarse sand at the rate of about two tons per mile should follow. If sawdust cannot be obtained, use fifteen pounds of coarse sand per sq. yd. as a vehicle to hold the kerosene; subsequent sanding will not be necessary. Particular attention must be paid to handling traffic during burning; smoke must not drift across the road; therefore burn on the lee side; signs and watchmen are necessary. Warm, dry weather is best or even necessary for this work.

If the excess bituminous material cannot be removed, roll in hard stone chips in warm weather; or apply a light cover of slow-setting bituminous material and apply the chips.



Types of vertical fiber lug paving brick. Depths are 2½", 3" and 3½"; width 4" and length 8½"; at right repressed lug block.

Make Your ROLLER SELECTION From the MOST Complete Line

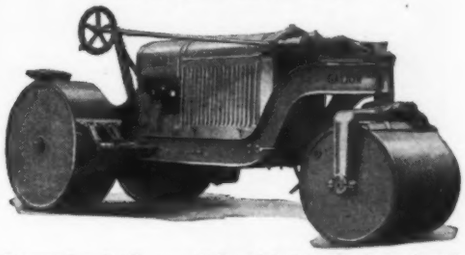


3-wheel rollers—two models, the Chief (illustrated) in 10 to 12 tons, and the Warrior in 6 to 8 tons both with either gasoline or diesel power. Roll-a-plane attachment can be supplied for both models.

And we mean complete line . . . for Galion builds a roller of a type and size for any requirement you may have. Practical, efficient and durable rollers with every feature and modern development to give them definite cost-reducing ability on the job.

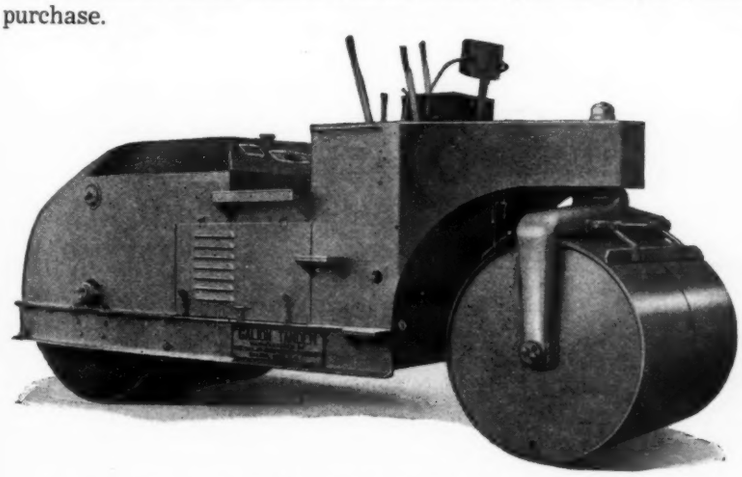
Greater top speed, quick hydraulic steering on heavier types, plenty of power, rugged construction and modern design . . . all contribute to the smoothness of operation and genuine utility.

Galion knows how to build road rollers . . . has been building them for years . . . always with the desire to help you put your road building and maintenance on a cost-saving basis. Let us tell you more about Galion rollers before you make your next purchase.

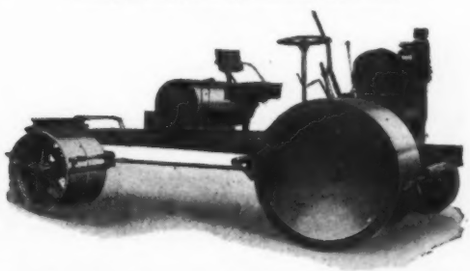


International rollers—a lightweight inexpensive unit with weight variable from 4 to 5 tons. International I-30 tractor unit.

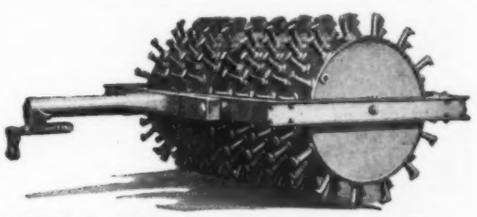
Portable rollers—for patch material, drives, lawns, etc. Weight variable by adding water to compression roll. Easily transported by attaching to truck.



Tandem rollers—with weight variable by adding water to rolls, from 5 to 14 tons. Two models. Gasoline or diesel power.



Trench rollers—for road widening work and close-to-curb rolling. Gives compression of a ten-ton, 3-wheel roller.



Sheepsfoot rollers—for tamping fills, new roads, etc. Single, double, tandem or any other suitable arrangement.

The Galion Iron Works & Mfg. Co.

Main Office and Works: **GALION, OHIO**

Export Division: **COLUMBUS, OHIO**

Highway Safety Work in New South Wales

A 65-mile section of the Great Western Highway in New South Wales was utilized for testing the efficiency of various types of traffic control devices. The experimental section has a bituminous surfacing for the greater part of its length and possesses varied characteristics of alignment and grading, the width of the roadway varying from 18 to 20 ft. Except in built-up areas concrete guide posts 3 ft. high were erected on all curves 4 to 6 ft. from the roadway. The spacing was calculated from a formula based on the radius of curvature. On transition curves a wider spacing was adopted. The posts on the curve proper were marked with black arrows, all of which pointed towards the centre of curvature. The spacing adopted at intersections was such as to give the appearance of an unbroken line of posts. Where curves were already provided with protective fencing, the posts at either end of the fence were also marked with a black arrow. Round, wooden posts painted white and spaced 300 to 500 ft. apart were placed along the inner side of curves. On straight sections white wooden guide posts were placed at each side of the road at intervals of 500 ft., the distance between posts being reduced to 300 ft. on sections where fog and mist are prevalent. A new type of warning sign was erected in advance of all sharp curves, cross-roads, etc. The sign consists of a red triangle of standard size bearing red and white glass reflectors placed alternately. Beneath the triangle is a yellow diamond with a black stripe close to the margins and bearing either black lettering or a black silhouette outlined with reflector studs, the centre of the diamond being 3 ft. 6 in. above ground level. The traffic lanes are divided through the length of the road section by a yellow painted stripe 3 in. wide. Wire mesh fencing was erected where necessary and existing fencing was extended. The measures were found greatly to increase safety, although research will continue, particular attention being paid to the use of reflectors of various types, especially on curbs and traffic lines.—*Road Abstracts.*

Grouting to Prevent Leakage Around an Earth Dam

(Continued from page 14)

wall moved slightly, a key sheared and was replaced, and the grout broke out 2 ft. south of 11+82.

Hole 11+87 was next grouted and after 1 hr. 20 min. grout rose in 11+97 and water overflowed hole 12+12 but soon stopped. 40.3 cu. yd. was injected in about 8 hours, at the end of which the pressure was high and grouting was discontinued.

Hole 11+97 was then grouted and high pressure immediately developed. After 1.4 cu. yd. had been injected the valve was closed for 3 min. and no pressure was lost, and grouting was discontinued. The same was true of hole 12+07.

Old hole 12+12 with only 11.2 ft. of casing was grouted, but it was believed most of the grout went into the upper part of the dam, since cracks developed in the surface. Grouting 12+32 and 12+67 built up pressure after a few minutes and it was believed further grouting was unnecessary.

The spring flow during this second grouting operation, with the lake at elev. 115.7, was reduced from 463 gpm to 15 gpm. A total of 371.3 cu. yds. of dry

material had been injected. The total cost to Marion County was $846.18 for material (of which $626.24 was for cement); $180 for county labor on equipment, $137.50 for regular county engineering services and $25.00 for miscellaneous. The two pumps used represented an investment of $445.00, the grouting machine was loaned by the State Highway Dept. Exclusive of depreciation on these, the total cost to the county was $1,203.58. The cost to the S. C. S. which furnished the labor and equipment for producing, hauling, drying and handling the clay and other materials, is not known to the county but it is estimated to have been approximately $6,000.00, which makes a total cost of grouting the leak equal to approximately $6.67 per gallon reduction.

Conclusions From These Operations

During these operations, suggestions as to procedure were noted that may be applicable to other similar operations.

1. The approximate level of the porous stratum must first be determined and all holes to be grouted cased to a point slightly above this, to prevent the grouting material breaking through to the surface before sufficient lateral flow is developed.

2. The use of a grouting pipe smaller than the drilled hole, with a collar between the two as described above, seems preferable to one that fits the hole, this permitting placing the collar and plug at any elevation desired.

3. These plugs must be set at least 24 hours before grouting commences to give them time to set; otherwise grouting may blow out the plug. By using a short length of grouting pipe at the bottom, extending above the plug, with left hand thread at its top and right hand threads at the other joints, it would be possible to salvage over 60% of the pipe, depending upon the depth of the hole.

4. At locations where the underground flow is sufficient to carry away grouting material, the speed with which injection is made is very important, and the ordinary highway mud jack does not have this speed.

5. Excessive pressure in grouting must be guarded against. Sufficient pressure must be exerted to cause lateral underground flow, but a failure of the surface may prevent continuous grouting and allow material injected to take initial set and prevent future work in the vicinity.

6. Before lowering the lake level to reduce head and volume through the leak, raise the elevation of the free water below the leak to the maximum amount if this is possible.

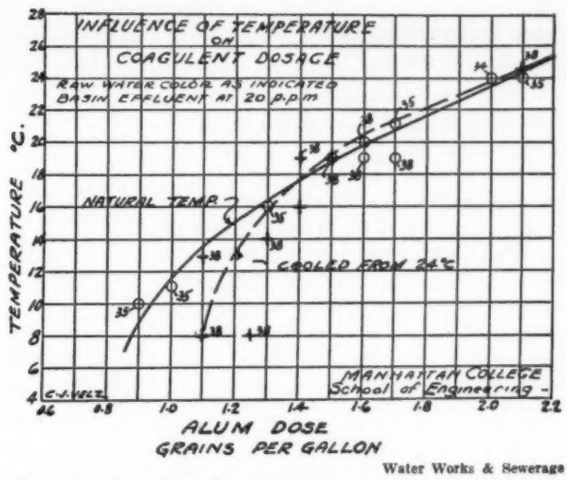
7. If sifted clay is used, stockpiling it after sifting, unless it is very dry, will cause it to reunite and form clods that will clog the mud jack. Such material must be moved at intervals to prevent caking.

8. If operations on any hole must stop for a period of over 4 to 6 hours (depending on the setting characteristics of the material used) the hole must be flushed thoroughly with clean water or it will be lost to future grouting. Adjacent holes must be flushed every 4 to 6 hrs.

The information from which this article was prepared was obtained from a report to the County Commissioners of Marion County by James F. Meisner, County Engineer, to whom we are indebted for the illustrations used.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.



Water Works & Sewerage

Temperature influence proved by coagulating artificially chilled samples.

Advantages of Flocculation

The main advantages of proper flocculation are: Improved quality of settled effluent because of effective coagulation; substantial saving in chemicals where such are used; less frequent washing of filters where these follow sedimentation; increase in sedimentation and filtration rates and therefore in plant capacity; general overall improvement and lower cost in plant operation.[G24]

Effect of Temperature on Coagulation

Temperature of the water is of primary importance in coagulation, evident when the dosage of coagulant is the minimum for effective results. The diagram shows the alum dose necessary at different temperatures, the solid line being temperatures occurring naturally at different seasons, the dotted line those secured by artificial cooling of summer water. The dose is doubled as temperature rises from 9° C to 21.5°. At summer temperature the pH must be reduced (in the water used in the investigation) to 5.6 to produce a basin effluent of 10 ppm with 1.5 grains of alum per gallon, but at 10° C. the same color removal can be obtained at pH 6.7.[G25]

Control of Raw Water Pollution

"This short article is a plea chiefly for more adequate control in the pollution of raw water, the provision of duplicate sterilization equipment to control emergency conditions, the installation of either automatic chlorine dosage or recording equipment and, when necessary, the raising of standards of quality of the finally treated water." "The examination of the finally treated water seems to call for analysis in larger amounts than 10 cubic centimeters."[F44]

Laying a 54-Inch Steel Intake Line

Syracuse, N. Y., in 1938 laid in Skaneateles Lake an intake to duplicate one laid in 1894 and no longer of sufficient capacity. The new intake was of 55″ o.d. arc-welded steel pipe 7/16″ thick, coated inside and out with bitumastic; furnished in 30 ft. lengths which were Dresser-coupled into 90 ft. sections, each section furnished with a bulkhead at each end, rolled down skids into the lake and towed to position by a tug (which had to be transported to the lake on a trailer). A 6″ water intake and 2″ air outlet were then opened and the pipe sunk to position and coupled up to pipe already laid by divers, using Dresser couplings. Laying began by setting a 60″ steel cross on a 3 ft. pedestal of crushed stone in 21 ft. of water, then laying 1500 ft. supported about 1 ft. above lake bottom by broken stone piers and an additional 2700 ft. in trench 0 to 13 ft. deep. Material excavated from the trench was dumped over exposed pipe already laid, using a mud scow. The work was done by the water department, using 16 regular employees of the city and 4 specially employed (divers and tug operators). Cost was $121,000 (28.71 a foot) including all preparation and equipment. The latter included two flat scows 65 x 16 ft. and a two-compartment mud scow 50 x 14 ft., all built at the lake by the department. The scows were used to support a ¼ yd. gas shovel slung between them on steel I-beams, used for digging the trench. For lowering the pipe they built a catamaran, using bulkheaded sections of the intake pipe for pontoons. The pipe towed by the tug was floated through the center of the catamaran and lowered to place by a cable fall at each end. Scows and catamaran were held in place by cables attached to piles driven at 150 ft. intervals 50 ft. each side of the pipe line.[A75]

Covers for Large Reservoirs

San Francisco has recently built three reservoirs with capacities of 81.5, 89.4 and 9.5 mg respectively. All are covered to prevent pollution by sea gulls and other birds, growth of moss, weeds, algae and insect life, contamination by wind-blown dust, and danger of children drowning in them. Comparing wood and concrete as roof material, the former would cost $63,000 less for the 491,000 sq. ft. of one roof, but was less economical when evaluated over the estimated life of the structure. Concrete was selected; total cost of roof, columns and footings was $389,000, or 79 cts. per sq. ft. Other advantages of concrete were absence of fire hazards (the city has lost two wooden reservoir roofs by fire), appearance and utility of a flat concrete roof for tennis courts or other playground purposes. The roof was designed for a live load of 75 lb. per sq. ft. It consists of a 2½″ slab supported by 5″ x 12″ concrete joists spaced 35″, these in turn supported by 13″ x 28″ girders, resting on 24″ round columns spaced 25 ft. centers designed as fixed-end cantilevers to resist horizontal forces due to temperature and earthquakes. Around the edges the girders are supported freely on a concrete coping, ventilation being afforded by a screened opening between this coping and the roof. The roof is divided by expansion joints at intervals of 225 to 250 ft.[F46]

Mass Destruction of Fish in Streams

During two drought years 1930 and 1931 mass destruction of fish occurred in the Schuylkill river; no cause was ascertainable by survey of the river or analysis of its water. Studies were made of the effect on fish in aquariums of scores of possibly poisonous materials added to the water. Many suggested some industrial wastes, but no adequate sources of these could be discovered. The author suggests, as the possible cause, cyanogenetic glucosides, naturally occurring vegetable substances, especially amygdalin; minnows contain the enzyme necessary to hydrolyze this; the action of the fish affected in the river was similar to that caused in these studies by placing cyanide in the water.[A76]

Sterilizing New Mains

Sterilizing newly laid mains by placing hypochlorite in the pipes as laid is of dubious value. Application of chlorine as the mains are filled is effective but does not sterilize the joint packing; hemp, even if sterilized, grows bacteria; jute is worse than hemp; even cotton yarn causes such growths. An organic mercurial sold as "Klerol" used to treat the hemp prevents aftergrowth for more than 60 days. A new packing of heavy-walled rubber tubing shows no indication of increasing the bacterial count. Use of this and swabbing the pipe with Klerol or chlorinating heavily after laying should give good results.[A78]

Automatic Control of Pumping at Baltimore

Baltimore's Pleasant Hill pumping station, completed last September, embodies the development of 25 years of experience by that city in pump control. Two 1,000 gpm centrifugal pumps, driven by 40 hp squirrel-cage motors, discharge through gate valves hydraulically operated and so tied to the motor starter that motor reaches full speed before discharge valve starts to open; and in closing, the discharge valve is almost fully closed before it trips the motor. A check-valved bypass around the valve serves to cool the pump if the discharge valve fails to open.[E22]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n*

May

75. *c.* Installation of a 54-inch Steel Intake Line. By E. P. Stewart. Pp. 759-770.
76. Fish Catastrophes During Droughts. By G. G. Schaut. Pp. 771-822.
77. WPA Projects in New York City. By P. Quilty. Pp. 823-831.
78. Investigation of Main Sterilization. By C. K. Calvert. Pp. 832-836.
79. Comments on Report on Depreciation. By R. Newsom. Pp. 837-840.
80. Proposed New Method for Determining Barrel Thickness of Cast Iron Pipe. By T. H. Wiggin, M. L. Enger and W. J. Schlick. Pp. 841-908.

D *The Surveyor*

May 26

19. *p.* Water Supply Problems. By J. Bowman. Pp. 685-686.
20. *p.* Purification of Water: Trend of Current Practice. By G. Baxter. Pp. 687-690.

June 2

21. *p.* Design and Construction of the Carron Reservoir. By P. B. Glendinning. Pp. 721-723.

June 9

22. Rhyl Waterworks Additions. P. 743.

E *Engineering News-Record*

June 8

21. Birthplace of the Filter—New Jersey. By M. N. Baker. Pp. 91-92.
22. Perfection in Automatic Pumping. By L. Small. Pp. 93-96.

23. Buried Pipes Made to Talk Back. Pp. 97-98.
24. To the Great Lakes for Water. By P. Hansen. Pp. 99-101.
25. New Data on Main Sterilization. By C. K. Calvert. Pp. 102-103.
26. Pumps to Meet Peak Demands. By D. D. Gross. Pp. 104-106.
27. Soft Water for St. Paul. By L. N. Thompson. Pp. 106-107.

F *Water Works Engineering*

June 7

41. Water Softening at Minneapolis. By J. A. Jensen. Pp. 672-678.
42. Price Tags for Water Systems. By R. Newsom. Pp. 679-681.
43. Delaware Water Supply System for New York City. By W. E. Spear. Pp. 682-686.
44. Significance of Raw Water Pollution Load. By N. J. Howard. Pp. 687-688.
45. Atlantic City's Water System. By C. Potts. Pp. 689-691.
46. Covers for Large Reservoirs. By N. A. Eckart. Pp. 692-695.
47. Interesting the Public by a Waterworks Movie. By R. E. Jordan. Pp. 696, 725.
48. Photomicrographs Used to Identify Micro-organisms. By G. J. Turre. P. 697.
49. Load Factor of Water Meters. By E. Nuebling. Pp. 702, 705, 713.
50. Operating Denver's Newest Filter Plant. By D. D. Gross. Pp. 714-725.
51. Reforming Florida Waters. By A. P. Black. 726-737.
52. Operating Results at Louisville. By N. N. Wolpert. Pp. 738-745.
53. Better Maintenance Needed to Improve Meter Performance. By A. T. Cook. Pp. 750-752.

June 21

54. *e.* Connecticut's Largest Reservoir. By C. M. Saville. Pp. 794-799.

G *Water Works & Sewerage*

May

19. Water Hammer Experiences and Correction. By H. Ryon. Pp. 169-173.
20. *p.* Study in Main Sterilization. By C. K. Calvert. Pp. 174-176.
21. Copper Sulphate in the Water Purification Plant. By. P. Weir. Pp. 177-181.
22. *p.* Maintenance of Tanks and Standpipes. By W. S. Staub. Pp. 182-184.

June

23. *p.* Raw Water Preparation for Filtration. By C. K. Calvert. Pp. 203-208.
24. *p.* Flocculation in Theory and Practice. By W. A. Darby. Pp. 209-212.
25. *p.* Flocculators and Coagulation. By C. J. Velz. Pp. 213-216.
26. Photographing Microscopic Organisms. By F. E. Smith. Pp. 230-231.

J *American City*

June

12. Sacramento Filtration Plant Built in Duplicate. By T. R. Kendall. Pp. 74-75, 119.
13. Water Softening Plant at Clarksburg, W. Va. Pp. 78-79, 109.
14. Rehabilitation Program of the Hammond, Ind., Water Works. By L. Besozzi. Pp. 82-84, 115.
15. Water Rates and Service Charges. Pp. 93-97.
16. Hydrant Inspection and Flushing in Montclair, N. J. By S. M. Weaver. P. 102.

P *Public Works*

June

27. Water Tower and Town Offices Combined. P. 9.
28. Stabilization and Corrosion Control by Threshold Treatment. By F. T. Redman. Pp. 15-16.
29. Operation and Maintenance of Water Works Distribution Systems. By W. A. Hardenbergh. Pp. 22-48.
30. *n.* Lowering Water Main Under Pressure. P. 63.

W *Johnson National Drillers Journal*

May-June

Iron Bacteria in Water Supplies. Pp. 1-5.

T *Technique Sanitaire et Municipale*

April

Les Corrosions des Canalisations de Distribution de l'Eau. By G. Richard. Pp. 54-60.

Liability for Damages From Suspension of Work

The construction of the pumping station and the laying of the sewer pipes for a sewage disposal system were awarded by a city to two different contractors. The contract for laying the pipes provided that construction work might be suspended for any reason if deemed advisable by the city engineer without additional compensation to the contractor and that the contract price should be accepted as full payment for all losses by suspension of the work. The work was suspended due to the first contractors failure to lay the foundation for the pumping station on time. The contractor for pipe laying sued the city for damages resulting from such suspension. The New Hampshire Supreme Court held, J. H. Ferguson Co. v. City of Keene, 200 Atl. 396, that the city was not liable in the absence of evidence that the engineer acted arbitrarily or capriciously or in bad faith.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

Cleaning Clogged Diffuser Plates

At Charlotte, N. C. treatment plant, five aeration units are equipped with diffuser plates, ridge and furrow type. Normal air delivery is 700 to 750 cu. ft. per minute per unit, 7.5 to 8.0 lbs. pressure. The plates in all units became badly clogged (possibly due to large quantities of brewery waste in the sewage) and were scrubbed with muriatic acid, which is standard practice. Two units refused to respond, air delivery remaining at 400 to 450 cu. ft. Chlorine gas was fed into header of one unit at 17 lb. per day and increased air delivery 66%; improvement maintained to date (six months). There is no evidence that chlorine has caused corrosion of feeder lines. Chlorine probably destroyed algae growth inside as well as on the surface of the plates and probably formed hydrochlorous acid which dissolved organic matter in the pores.[G19]

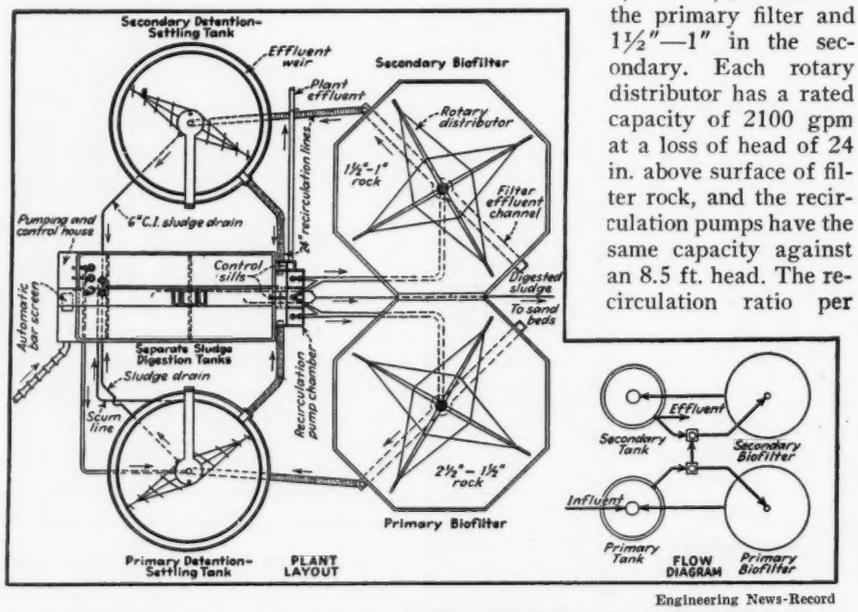
Avoiding Pipes in Trenching

A device called a "pipe anticipator" has been used in New Jersey which, attached to ditching machine, trench hoe, etc., indicates by sound if the excavating agent is approaching a buried pipe. It is a compact radio mechanism, including an oscillator, amplifier, speaker and earphone. The volume of sound increases with the nearness of the excavating agent to the pipe; and can be adjusted for various soils.[E14]

Rapid Biofilters at Petaluma, Calif.

A biofiltration plant has been in operation at Petaluma, Calif., since September, 1938, treating sewage having a population equivalent of about 32,000, with a peak flow of 1.25 mgd. Adequate purification requires about one-half as much power as an activated sludge plant of the same capacity. Complete cost of plant was $85,000, exclusive of pile foundations.

The raw sewage is first diluted with effluent from the primary trickling filter and discharged onto this primary filter through a rotary distributor, and the effluent from this goes to the primary settling tank. The partly oxidized effluent from this stage is then diluted with effluent from the secondary filter and distributed over this filter, the effluent from which is part mixed with primary effluent and the rest discharged to the stream. Each filter is 75 ft. diameter and contains 3 ft. depth of stone, 2½" — 1½" stone in the primary filter and 1½"—1" in the secondary. Each rotary distributor has a rated capacity of 2100 gpm at a loss of head of 24 in. above surface of filter rock, and the recirculation pumps have the same capacity against an 8.5 ft. head. The recirculation ratio per stage can be varied from 3:1 to 6:1 in either stage. The power required is 15 hp. per million gallons of sewage of 300 ppm of B.O.D.[E15]



Engineering News-Record

General layout and flow diagram of plant designed for two-stage treatment.

Power From Sewer Gas

Of 13 plants which have used sewage gas power for some time, varying in size from 30 to 535 hp. created, all showed a net saving from such use, with a very low cost of repairs compared to power production, and of lubricating oil in most cases. In most, if not all, plants the engines are operated by the regular force—no additional men. All reported generation of power by sewer gas as satisfactory and practical.

The most serviceable type of gas engine is the heavy-duty slow-speed; which should be good for 15 or 20 years with low maintenance and repair cost; valve-in-head for small sizes, valves in removable cages in the larger. Other desirable features: unit-block frame bolted direct to engine base; cylinder heads as separate castings; removable cylinder liners and valve-seat inserts for exhaust valves; valves readily removable; main bearings mounted in engine base and readily removable; water jacket space accessible for cleaning; flywheel, if engine drives a generator; governor to control engine speed; safety devices; piston speed not over 1000 fpm; brake mean effective pressure not over 70 lb. per sq. in.

Few plants have trouble from hydrogen sulphide, but several have installed a commercial type of scrubber. Most recover part or all of the waste heat from the engine in the jacket cooling water and in the exhaust gases.

A fair allowance for repairs is $2.00 per bhp per annum; for lubricating oil, 1 gal. for 2,000 bhph. The gas engines used by the plants reporting include 7 Worthington, 2 Le Roi, one each of Clark, Buda, Climax and Rathbun.[G16]

Power From Sewage Gas

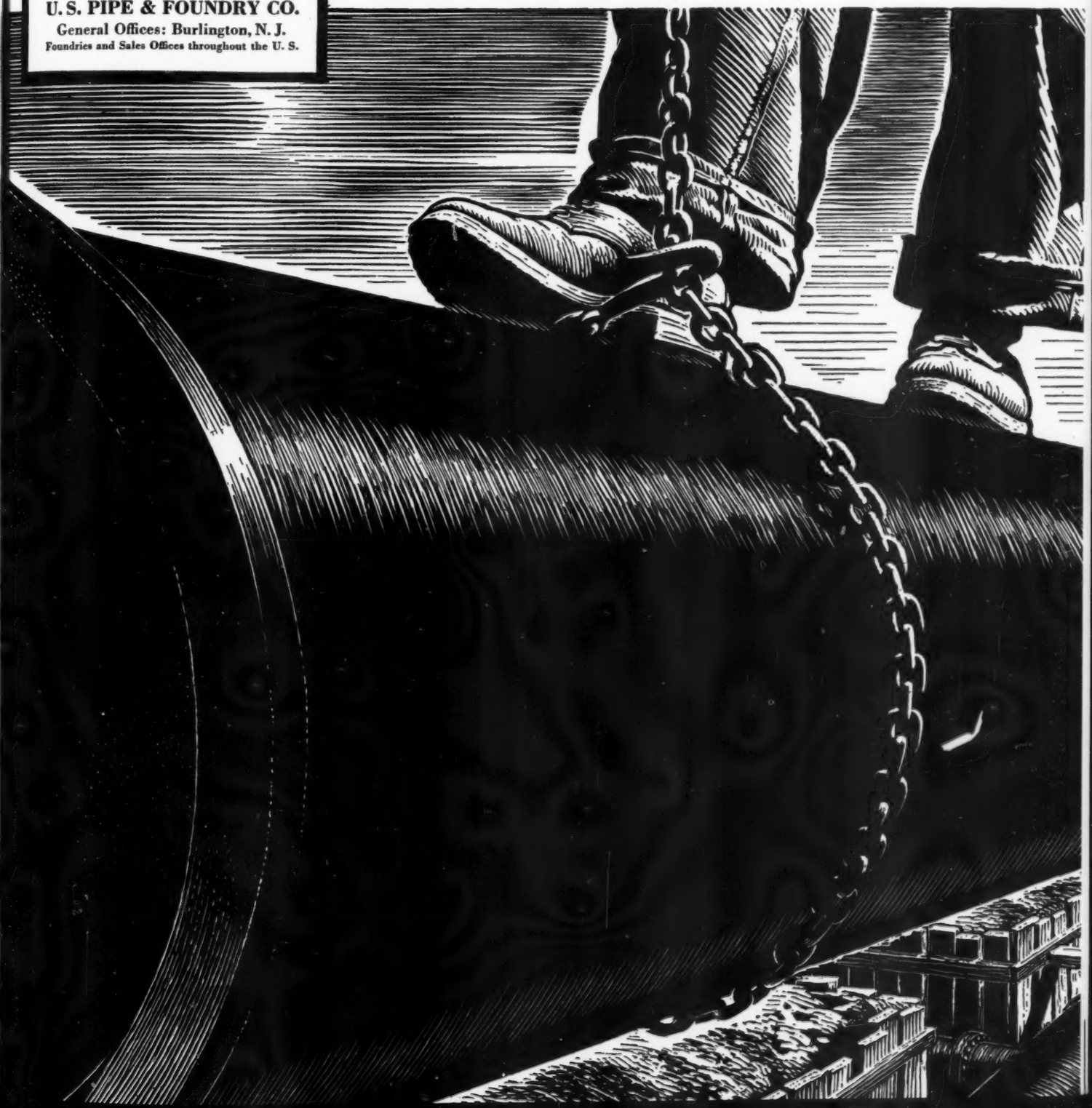
The average sewage gas from United States plants has 637 B t u per cubic foot gross heating value and 580 net heating value, and requires 5.604 cu. ft. of air to burn one cu. ft. of gas, giving a

U.S. cast iron PIPE

Centrifugally or pit cast for water, gas, sewerage, drainage and industrial service.

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Foundries and Sales Offices throughout the U. S.

AS time goes on, estimates of the life-expectancy of cast iron pipe grow higher. In an address at a convention last month a nationally known water works engineer put it at 180 years. However, history has yet to limit the span of useful life of cast iron pipe. We, who make it, are content to say—*more than a century.*



value of 87.9 B t u per cu. ft. of the mixture, which is on a par with most natural gas. Practically the only undesirable feature in the use of sewage gas is the hydrogen sulfide content, averaging about 0.4%. The acid formed by combination of this with water vapor in the engine is very corrosive, and all copper gaskets and brass parts in the engine should be tinned or made of acid-resisting material. If the hydrogen sulfide does not exceed 0.04%, standard gas engines made for natural gas may be used. The gas may cause trouble outside the engine by depositing a film of sulfide upon the moving parts of the gas regulating and mixing valve, causing erratic operation sometimes blamed on the governor.[H33]

Accessories of a Refuse Incinerator

Schenectady, N. Y., last December let a contract for an incinerator plant to include two 105-ton, 3-cell units of the pit and crane type, provided with accessories for scientific operation and study of the plant. These include pyrometer equipment and draft gauges in the north unit as follows: Thermometer in suction duct of forced draft fans; thermocouples in the preheated air duct, in furnace chamber (giving temperature at level of bridge wall or near roof), in first and second sections of the combustion chamber, in lower chamber of preheater, in expansion chamber, and at top and bottom of chimney. Five pyrometers, two of them recording, can be connected to any thermocouple. In the south unit thermocouples will be installed in the ash pit and combustion chamber only. Using the ten thermocouples, simultaneous temperatures can be determined of air in fan suction, preheater, furnace chamber, combustion chamber, expansion chamber and top of chimney. In the north unit, draft gauges are installed in the fan suction to determine air duct losses; in the ash pit to determine positive or negative pressure for gravity or fan operation; in the furnace chamber to determine drop of pressure through full bed; in combustion chamber to determine losses of pressure resulting from gas flow, turns and changes of velocity; in expansion chamber to determine unit flue and velocity change losses; in the upper and lower compartments of the tubular preheater to determine losses through preheater tubes.[H34]

Three-Stage Digestion in Holland

The Hilversum, Holland (36,000 population) treatment plant consists of screens, detritors, digesters, aeration and final settling tanks and sludge beds. The digesters are 3-stage; in the first tank the fresh solids are seeded, mixed, heated and kept for 24 hrs. or longer; primary digestion takes place in the second tank; the third tank is provided for after-digestion and storage. The supernatant from the third tank is clear with little suspended material and relatively low B.O.D.; which is undoubtedly aided by the rectangular shape of tank, with inlets and outlets far apart. Sludge is heated to about 32° C in the first tank by means of hot water coils on a hollow rotating shaft, allowing gentle mixing of the fresh solids with the ripe sludge. The digesters have square floating covers. Aeration is by revolving brushes, an adjustable outlet permitting increasing agitation by raising the level of the sewage in which the brush revolves.[G17]

An Automatic Treatment Plant

Vught, Holland, has a treatment plant that is entirely automatic. The sewage from 5,300 connected population, with waste from 5 power laundries some days exceeding the domestic sewage, is settled in 2-story tanks, aerated with revolving brushes, passed through Dortmund settling tanks; the sludge

goes to separate digesters with horizontal mixing and heating apparatus. The plant is entirely automatic; one man each Monday morning takes meter readings, oils the machinery and draws sludge from the digesters if necessary. B.O.D. is reduced from 300 to 12 ppm. "This appears to be the first municipal activated sludge plant operated by remote control and persistently producing a high-grade effluent at low cost."[G17]

Lining a Sewer With Gunite

Three thousand feet of 36″ segment block sewer in West Hartford, Conn., which leaked badly from a brook above was lined with gunite about 1.5″ thick reinforced with 14-gage wire of 2″ mesh. The small diameter presented a difficulty; the nozzleman was drawn through seated cross-legged on a carriage with 8″ rubber-tired wheels. Several leaks were allowed to flow until all the rest of the area was covered, then plugged with Sica.[J11]

Cleaning an Outfall Sewer

A 54″ cast iron outfall sewer in Salem harbor, Mass., and a 48″ cast iron pumping main discharging into it, were found to be so heavily coated inside with a hard scale formation as to greatly reduce their carrying capacity, chiefly due to caustic lime from tanneries. A cleaning machine such as the National Water Main Cleaning Co. use for water pipe was tried on the 3400 ft. of 48″ pipe and cleaned it completely. Then the 8,300 of 54″ outfall was similarly cleaned; the travel of the machine through the outfall being followed by means of a hydrophone and two directional listening devices. It cleaned the total 8,300 ft. in 2 hr. 38 min. and was recovered at the outlet by a diver. The cost was $1,000 for the smaller line and $2,500 for the larger.[J10]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

E *Engineering News-Record*

June 8

14. Buried Pipes Made to Talk Back. Pp. 97-98.

June 22

15. Rapid Biologic Filters for a Sewage Plant. (Petaluma, Calif.) By H. N. Jenks. Pp. 51-53.

G *Water Works & Sewerage*

May

16. Principles of Power Generation with Sewage-Gas Engines. By N. C. Wittwer. Pp. 161-168.
17. Some New Developments in Sewage Treatment in Holland. By W. Rudolfs and H. Kessener. Pp. 185-189.
18. Sewer Maintenance in Atlantic City. By J. H. LeChard. Pp. 190-192.

June

19. Purging Diffuser Plates with Chlorine. By W. M. Franklin. Pp. 232-233.
20. Sludge Filtration: Sludge Conditioning. By L. W. Van Kleeck. Pp. 234-237.
21. Screenings Destruction at Milwaukee. By G. R. Lewers. Pp. 238-239.
22. Cape May's New Diesel Sewage Works. By E. Schoonmaker. Pp. 240-242.

H *Municipal Sanitation*

June

33. Sewage-Gas Engines. By B. C. Thiel. Pp. 310-313.
34. Accessories Add to Efficiency of Incinerator. By H. W. Taylor. Pp. 314-315, 324.
35. Diesels Drive Sewage Pumps. Pp. 316-317.
36. Maintaining Meters, Gauges and Control Apparatus. By L. M. Johnson. Pp. 318-320.

J *American City*

June

10. Water-Main Cleaning Methods Used in Outfall Sewer. By C. L. Nyman. Pp. 71-73, 109.
11. Saving a Segment Block Sewer with Gunite Lining. By F. B. Chamberlin. Pp. 80-81.

P *Public Works*

June

27. Modern Secondary Sewage Treatment with High-Rate Sprinkling Filter. Pp. 10, 12.
28. Cape May's New Diesel Sewage Pumping Station. By E. Schoonmaker. Pp. 13-14.
29. Garbage Collection and Incineration in Milwaukee. P. 18.

Keeping Up With New Equipment

Speeder Johnson Front-Dumping Shovel

Something new in excavating machinery is announced by the Speeder Machinery Corporation, Cedar Rapids, Iowa. Officially called Johnson Front-Dumping Shovel, it has quickly been nicknamed "Speedersaurus" or "double-jointed rip-snatching scooper-dooper." The action is somewhat like that of a trench hoe, but in reverse.

This patented shovel attachment, developed for use with Speeder or Link-Belt convertible machines, has been designed for handling material that cannot advantageously pass through the bucket, and for sub-grading work where a skimmer might ordinarily be used. As there is no hoist line running down to the top of the bucket, it can work in places where an ordinary shovel might foul.

Front Dumping Shovel

The new unit is particularly suited for land clearing work, digging out trees, stumps, boulders; drainage ditch clean-outs and the building of new ditches; ripping up and loading old concrete or macadam paving; loading peat moss; etc. The operator can balance a slab on the bucket and practically lay it into truck.

Further information from Speeder Machinery Corporation, 1201 Sixth Street S. W., Cedar Rapids, Iowa.

The Simplex Summator

Bulletin 70, Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa., describes the "Summator," which is designed to add the flow of two or more metering devices to give the sum of the flow; or it can be arranged to indicate the differences between the individual flows or ratios of any group of metering instruments and to operate controls from these results. Sent on request.

The M.S.A. Chlorine Mask

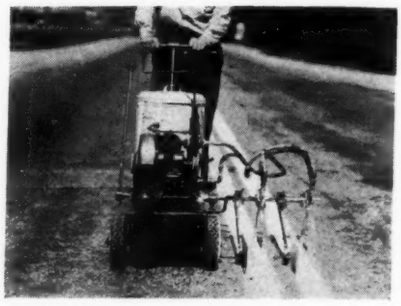
Mine Safety Appliances Company of Pittsburgh, Pa., announces the M.S.A. chlorine mask with GML canister, a mask which provides the correct type of protection against chlorine gas.

Officially approved by the U. S. Bureau of Mines for respiratory protection against chlorine, the mask has an entirely new canister developed solely for chlorine service, which supplies the user with greater protection over a considerably longer period than previous types of canisters. Described in bulletin ED-5. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.

New Littleford Line Marker

Littleford Bros., Cincinnati, Ohio, has developed a new "Traf-O-Line" marker, featuring a new operating action. This marker has no pressure tank or gravity drain, and works on an entirely new basis.

This new machine will spray paint, cut-back, asphalt, etc. The amount of paint to be applied can be regulated by a hand control. Fuel costs about ten cents per day. It has a self-propelling feature; but can be pushed by hand as easily as a go-cart. It can mark lines any width, straight, curved, or dash lines; circles or figures are easy to make.



Littleford Traffic Line Marker

It was developed for Highway Departments, cities and towns of all sizes, large industrial companies for marking factory floors, parking spaces, street railways, Park Departments and Athletic Fields. It cleans itself by a new method. Further details from Littleford Bros., Cincinnati, Ohio.

Aqua-Method of Ammoniation

Aqua ammonia can be used with the Proportioneers Amm-o-Feeder for water treatment. The procedure recommended by Proportioneers is as follows: 1. Buy a standard 110 or 55-gallon drum of 26° Baume aqua ammonia: 2. Substitute the injector pipe in the drum cover instead of the screw plug found in standard ammonia shipping drums: 3. Turn on compressed air and, 4. blow the ammonia into a diluting tank and attain proper dilution by gauge glass observation: 5. Blow the dilute ammonia into a weigh and feed tank mounted on a platform scale, and, 6, feed the ammonia solution into pipe lines under pressure with an Amm-o-Feeder. The feeder measures the solution volumetrically and this can be checked against scale readings.

For smaller plants, a simpler layout can be provided; if desired, the ammonia can be fed directly from the original shipping container. Feeders for handling ammonia are available in plunger type for high concentrations and in the rubber diaphragm type for dilute concentrations. These two feeders come in two pressure designs—one for pressures up to 60 pounds; the other for pressures from 60 to nearly 200 pounds. Proportional feeding is obtained by cross connections with pumps or by controlling the feeder by means of a water meter.

Further information on layouts to meet special problems can be obtained from Proportioneers, Inc., 9 Codding St., Providence, R. I.

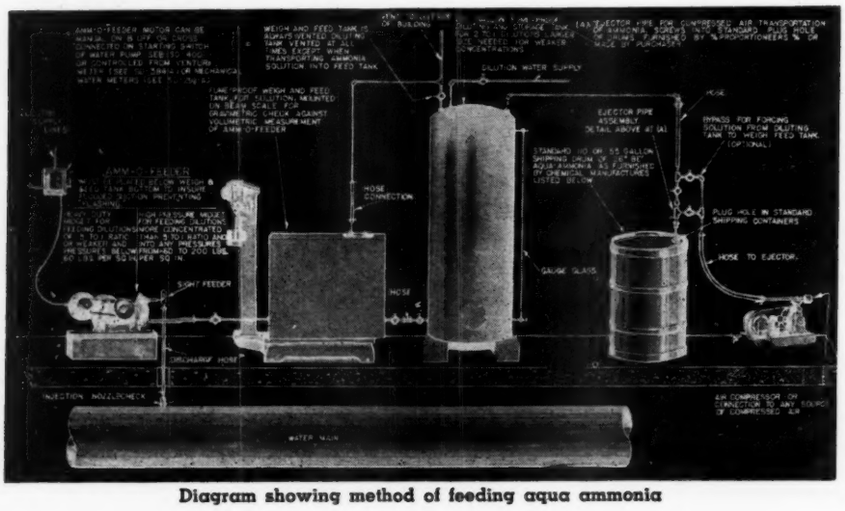
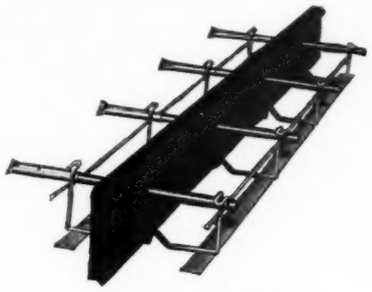


Diagram showing method of feeding aqua ammonia

A New Road Joint Assembly

The dowel bars commonly used and approved by the Bureau of Public Roads to transfer a load from one paving slab to the next can function properly only if they are held absolutely parallel to the line of motion of the adjacent slab. To accomplish this they must be placed and held parallel to each other, to the subgrade, and normal to the joint filler material whatever it may be.

The picture shows how the Union Assembly Unit dowel bars are positively engaged and locked in parallel and normal position, and how the cross member centers the bottom of the filler to insure proper projection of the dowel on each side of the joint. After the dowels are snapped in place under the patented locking mechanism, it is not possible for handling or job usage to dislodge them from their position.



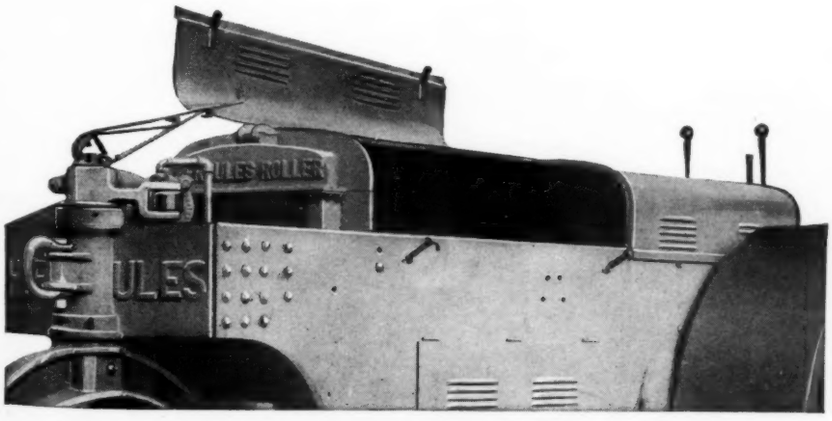
Union Assembly Unit

If the paver is working alongside of the subgrade the complete assembly can be placed ahead of the work so that there is no interruption whatsoever, but if the paver is traveling down the subgrade ahead of the concrete these units can be placed so quickly that there is a minimum delay or interruption in the paving operation. This unit is made by the Union Steel Products Co., Albion, Mich.

Hercules Roller Improvements

The Hercules Company, Marion, Ohio, has announced two new improvements on its Ironeroll rollers. The old style bevel reversing gear for controlling the forward and reverse movement of the roller has been replaced by spiral tooth gears which give smoother, quieter and much longer operation. The gears are of alloy steel, cut teeth, and heat treated.

Another improvement is the hinging of the engine hood. Formerly the hood was made in one piece and was quite difficult for one man to remove. The hood is now divided and hinged similiar to automotive types and can be raised from either side of the roller by one man with ease. This feaure materially increases accessibility to the motor for necessary adjustments.



Hinged engine hood is one of the improvements announced on Hercules Rollers

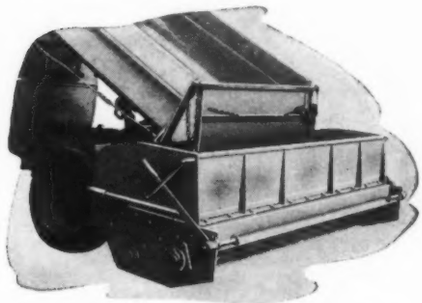
U. S. Vertical Syncrogear motor unit incorporates a small geared oil pump for lubrication. Fuller information from U. S. Electrical Motors, Inc., Los Angeles or San Francisco, Calif.; Chicago, Ill.; Boston, Mass.

New ½ and ⅝ Byers Shovels

A new ½ yd. and a new ⅝ yd. convertible crawler power shovel are being produced by The Byers Machine Company, Ravenna, Ohio. Model 65, the new half-yard, weighs 30,000 lbs., is powered by a 50 H.P., 6 cylinder motor and has a safe crane lifting capacity of 12,500 lbs. at 10 ft. radius on a 30 ft. boom. Model 75, the new five-eighth yard, weighs 32,500 lbs., has a 60 H.P., six cylinder motor and lifts 13,000 lbs. Data on both sent on request.

A New Method of Washing Grit

Satisfactory removal of grit from sewage by means of channels is difficult or impossible. It is still more difficult to wash the grit so as to remove the putrescible matter. The new Jeffrey grit washer is said to remove more than 80% of the putrescible solids, so that the washed material can be used for fill, walks or roadways. A complete description, with considerable design data, is provided in the new Jeffrey Catalog 698, which will be sent on request. Jeffrey Mfg. Co., Columbus, Ohio.



Handy Sandy spreads sand to 2" stone. Good Roads Mach. Corp., Kennett Sq., Pa.

Buckets for Incinerator Plants

An improved power-wheel all-alloy steel bucket for use in incinerator plants has been introduced by Blaw-Knox Company, Pittsburgh, Pa. The accompanying illustration is a shop photo of five of these buckets constructed for incinerator plants at Cedar Rapids, Iowa; New Rochelle, N. Y.; Schenectady, N. Y.; and two for Cincinnati, Ohio. The new buckets are of 1½ cubic yard size, power-wheel type, weighing 3,950 pounds each. They are built for fast action and low headroom conditions. Circular wearing pads on the sides of the scoop protect the rivet heads from abrasive contact with the concrete sides of refuse pits.

Incinerator Buckets

A new feature is the use of cable rather than chain on the power wheel, the objective being to reduce maintenance costs; it also permits use of the good sections from worn-out hoisting lines.

It is believed that these are the first all-alloy incinerator buckets. Special alloy steel lips are constructed of material with minimum physical properties of 106,000 pounds per square inch in tensile strength; yield point of 80,500; elongation of 18 per cent in two inches; and reduction in area of 30 per cent. The material throughout has minimum physicals of 85,000 tensile and 55,000 yield point.

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

Construction Materials and Equipment

Air Compressor from Ford Parts

5. How you can convert an ordinary Ford model A or B motor into an air compressor for operating jackhammers, paving breakers, clay spaders, tampers, paint sprays, etc., is explained in a new bulletin just issued by Gordon Smith & Co., Desk G, 516—10th St., Bowling Green, Ky.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42d St., New York, N. Y.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Dirt Moving Efficiency

65. "Dirt Moving," is a new 32 page booklet illustrating the use of Trac Tractors as a source of money-making power for bulldozers, bullgraders, wheel scrapers, fresnos, graders, dump wagons, tampers, etc. 24 pages of action pictures, directions, etc. Sent promptly by International Harvester Co., 180 No. Michigan Ave., Chicago, Ill.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches—for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Culvert Mfrs. Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

Finisher

78. A very complete, 36 page illustrated booklet on the Barber-Greene Tamping-Leveling Finisher explains its important features, principles of operation, types of jobs it handles and materials laid. Ask for catalog 879, Barber-Greene Co., 635 West Park Ave., Aurora, Ill.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

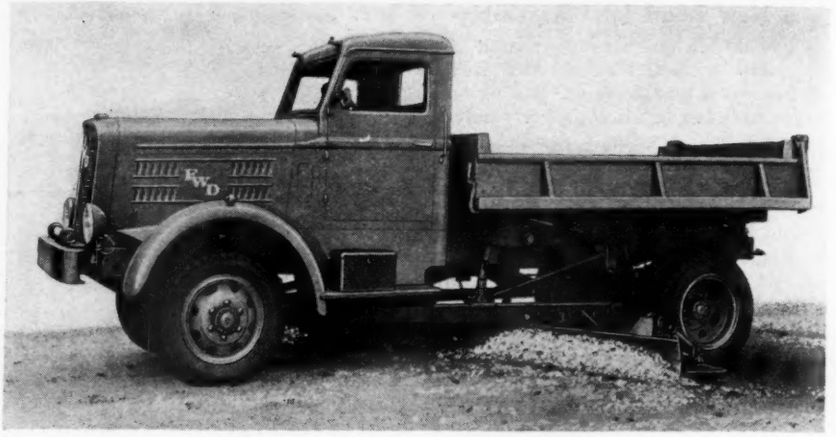
Mud-Jack Method

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Brick

116. Standard specifications for vitrified brick pavements and brick parking strips and gutters, as adopted by the American Society of Municipal Engineers. Also standard specifications for bituminous filled brick pavements adopted by the American Association of State Highway officials. If you contemplate using brick for paving, you should have a set. National Paving Brick Ass'n, Washington, D. C.

(Continued on page 51)



Four-Wheel Drive Maintenance Unit

FWD Truck and Underbody Blade

A new Model HG, equipped with underbody blade and with many refinements and improvements, has been announced by The Four Wheel Drive Auto Company, Clintonville, Wisconsin, and Kitchener, Ontario, Canada. This unit was designed to meet specific needs in the highway field. primarily for underbody blade service, but also for use as a truck. It is suited for snow removai, with either a one-way or "V" type plow. With 154" (standard) wheelbase, the new Model HG has a chassis weight of 6800 pounds with cab included. The gross rating is 16,000 pounds. The chassis may be equipped with either an 8′ or 10′ body. Speeds 4 to 33 mph.

Austin-Western Plant Developments and Changes

Along with plans to erect new additional buildings and consolidate all manufacturing facilities at Aurora, Illinois, S. F. Beatty, President of the Austin-Western Road Machinery Co., has announced the following executive changes: Vice-President F. L. Jerome has been made Assistant to the President; Vice-President H. M. Kleiser has been placed in charge of Sales, Advertising, Service, and Research; R. K. Stiles has been made Sales Manager; A. O. Teckemeyer will become Manager of Governmental Sales Division.

Austin-Western formerly distributed its products through coast to coast branch office sales organizations, but a year and a half ago the marketing setup was changed and now this company distributes its complete line of road building, rock crushing, earth moving, and street cleaning machinery through well-known machinery equipment dealers, located throughout the country and in all parts of the world.

New Osgood Excavators

A new combination Shovel, Dragline and Crane in the 1-1¼ yard class has been announced by The Osgood Company, Marion, Ohio. This is designated as the Type 60, and is available as the Model 600 with 20 foot boom, 16 foot handle, 1 cubic yard dipper, 100 H.P. gasoline motor, 11′ 10″ crawlers, and as the Model 605 with 21 foot boom, 16 foot handle, 1¼ cubic yard dipper, 120 H.P. gasoline motor, 12′ 3″ crawlers. Diesel power may be substituted for gasoline.

Illustrated descriptive specifications of the Type 60 as Model 600 and Model 605 are available from any Osgood distributor, or direct from the home office of The Osgood Company at Marion, Ohio.

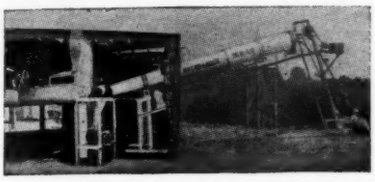
Kwik Mix Concrete Mixer with Rubber Roll Drive

Here is a new-design, neat appearing concrete mixer, 3½-S, non-tilt, which has been announced by the Kwik Mix Concrete Mixer Co., Port Washington, Wisc. Outstanding features are the absence of the drum ring gear, drum drive pinion and countershaft. The drum is driven with rubber drum rollers, which greatly reduce noise, vibration and, according to the makers, maintenance costs. Low loading height; weight 980 pounds.

The Ruth dredger, now made by Bucyrus-Erie builds and cleans ditches and canals, working under wet or dry conditions. Adjustable to desired widths.

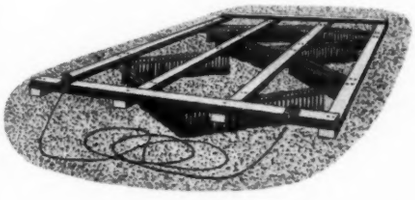
Overmander Bituminous Mixing Plant for Street Work

This plant is claimed to mix bituminous materials at a very low cost. It consists of a drying unit, mixing unit, compressor, elevator and bin, which can be dismantled and hauled from place to place on a truck or trailer. It is controlled by a master switchboard which makes it entirely responsive to the will of the operator. The new one-man plant



Thumb-nail photo of Overmander mixing plant

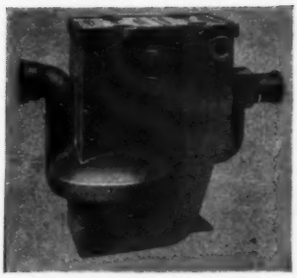
weighs only 7400 pounds, uses 7¾ hp.; the storage bin has 5 to 10-ton capacity; the burner lights with an electric spark. A lot of most interesting information for the street maintenance man will be found in literature which will be sent on request. Overmander Machine Co., Marion, Indiana.



This is the Toaspern road plane. Designed for medium-heavy or light surface treatment up to 35 pounds per sq. yd.; for manipulation of chips on penetration and seal coats; light retreads and maintenance. Good Roads Machinery Corp., Kennett Sq., Pa. will furnish full data

Galion Leaning Wheel Grader

The new No. 210 leaning wheel grader announced by Galion Iron Works & Mfg. Co., Galion, O., weighs 7765 pounds and has a 10-ft. blade. The moldboard can be shifted up to 80 ins. for shoulder cuts, and bank cuts can be made up to 90° from the horizontal with a total vertical reach of 11 ft. Fuller data are given in Bulletin 234.



Solus Oil and Gasoline Separator

The Solus Oil and Gasoline Separator

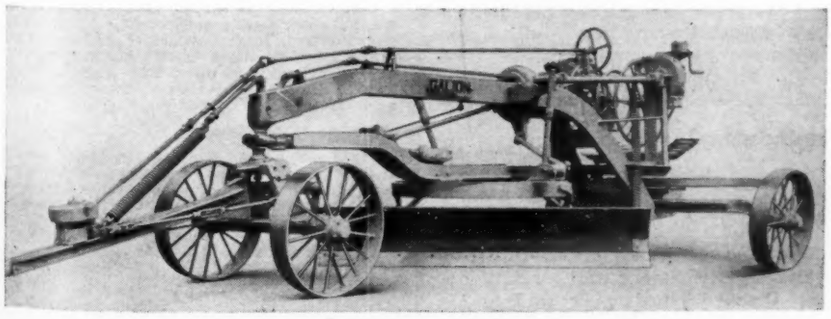
The Solus Oil and Gasoline Separator prevents sewer explosions by keeping such elements as oil and gasoline from entering the sewerage system. Made of one piece cast iron; cleaned from the floor; no pit to enter; operates on a basis of 95% efficiency. When the oil retaining capacity of the Separator is reached the discharge is automatically stopped by the lowering of the brass float which also acts as a cleanout signal and is actuated by the specific gravities of oil and water. When the separator is cleaned the float rises and permits the normal flow to pass through.

The Solus is the only separator approved by the Fire Underwriters' Laboratories. For use in drainage systems of garages, filling stations, airports, dye houses, paint houses, manufacturing plants, cleaning establishments, etc. Catalog and information from Central Foundry Company, 386 Fourth Avenue, New York, N. Y.

New Officers of the New England Water Works Association

The Nominating Committee of the New England Water Works Association, has submitted the following nominees for officers:

For President—Percy A. Shaw, Superintendent and Engineer, Manchester Water Works, Manchester, N. H., for one year; for Vice President—Francis H. Kingsbury, Senior Sanitary Engineer, Massachusetts Department of Public Health, Boston, Mass., for two years; for Director—Karl R. Kennison, Chief Engineer, Metropolitan District Water Supply Commission, Boston, Mass., for three years; for Treasurer—Abel Reynolds, Treasurer, N. E. Water, Light and Power Associates, Providence, R. I., for one year.



The New Galion Leaning Wheel Grader

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

(Continued from page 50)

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from 1½" to 8", including lightweght models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Retaining Walls

126. Charts showing the design of cellular or bin-type metal retaining walls, helpful suggestions on their use for stabilizing slopes, preventing stream encroachment, and solving problems of limited right of way, and construction details are given in a 16-page bulletin entitled, "ARMCO Bin-Type Retaining Walls." It is published by the Armco Mfrs. Association, Middletown, Ohio, and member companies. Ask for Bulletin H-37.

Road Building and Maintenace

127. See road work as it was done in the 1890's and as it can be done by a full line of this year's road building equipment. See, in this new action picture book, the first reversible roller, 1893 World's Fair Award Grader and how methods have changed. Attractive new booklet AD-1796 recently issued by The Austin-Western Road Machinery Co., Aurora, Ill.

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalog 200 issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Rollers

130. New bulletin describing in detail the new Huber Road Rollers will be sent promptly on request by the Huber Mfg. Co., Marion, Ohio.

132. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

Shovels, Cranes and Excavators

145. The Austin-Western-Badger, a fully convertible ½ yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A-5 Aurora, Ill., is fully described and illustrated in their Bulletin No. AD-1683.

146. New catalog picturing the detailed construction of Osgood "Chief" power shovel and illustrating it as shovel, clamshell, dragline, crane and piledriver. Write The Osgood Co., Marion, Ohio, for your copy.

147. Individual illustrated folders are available on the several models of "Speeder" convertible shovels, draglines, cranes, made in ⅜, ½ and ¾ yd. sizes. Ask for complete set or specify size of machine. Write Speeder Machinery Corp., 1201 Sixth St., Cedar Rapids, Iowa.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set

(Continued on page 52)

Readers' Service Department

(Continued from page 51)

forth the principles and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

155. "Better Bases for Better Roads" is a useful new booklet describing and illustrating the use of calcium chloride stabilized graded aggregate mixtures for pavement bases. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Bituminous Materials

202. The maintenance of all types of roads and streets is the subject of this 52 page booklet which will be sent on request by The Barrett Co., 40 Rector Street, New York, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

211. A complete booklet on dust control titled, "Dust Control and Road Stabilization," describes the use of Columbia Calcium Chloride for dust control purposes and stabilization of roads. Sent on request by The Columbia Alkali Corp., Barberton, Ohio.

Sanders

270. Galion's new, inexpensive sander for quickly spreading sand, stone dust, cinders, chips, rock salt, calcium chloride, etc., is described and illustrated in a new circular which will be sent on request by Galion Iron Works & Mfg. Co., Galion, Ohio.

Street Markers

295. A new combination highway and street traffic marker and paint sprayer in an 8-page folder issued by Melli-Blumberg Corp., New Holstein, Wis. It is rugged, speedy, easy to operate, stripes straight or curved lines perfectly. Before buying a traffic marker be sure to send for this folder.

Snow Fighting

Plows

349. "Frink V Type Sno-Plows" is a 24 page catalog fully illustrating and describing 8 models of V Type Sno-Plows for motor trucks from 1½ up to 10 tons capacity, 16 models of Frink Leveling Wings, the Frink Hand Hydraulic Control and the latest Frink Selective Power Hydraulic Control. Data are given for selecting the proper size V plow and wing for any truck. Issued by Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Sanitary Engineering

Anaylsis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use," is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

HOW TO ORDER: These booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

A Bigger and Better AWWA Meeting

The 59th annual convention of the American Water Works Association, which was held at Atlantic City, N. J., June 12 to 15, was perhaps the best that has ever been held. Registered attendance was about 1300. The equipment exhibit was excellent, due largely to the efforts of J. Herman Smith, in charge of the exhibits, and this contributed materially to the success of the convention.

This convention differed from most of its predecessors in that the exhibits and the meetings were held in the Auditorium, several blocks distant from the hotel which was the headquarters. The result was so satisfying that the 1940 convention will be held in the Kansas, Mo., auditorium.

Arthur Jensen of Minneapolis was elected president of the association succeeding Reeves Newsom of New York. Many awards of medals and presentation of honors were made. The Diven medal was awarded to Hal F. Smith of Detroit; the Goodell prize to David G. Thompson and A. G. Fiedler; honorary memberships to Frank A. Barbour of Boston, Carlton E. Davis of Bryn Mawr, Pa., Charles Gilman Hyde of Berkeley, Calif., Beekman C. Little, for many years secretary and now secretary emeritus of the AWWA, and Harry E. Jordan, present secretary.

The George W. Fuller awards went to G. E. Arnold, the California section; A. M. Bowman, Canadian section; E. C. Trax, Central States section; A. P. Black, Florida; J. W. Armstrong, Four States; John R. Baylis, Illinois; H. A. Dill, Indiana; H. F. Smith, Michigan; J. W. Pray, Missouri; F. E. Brandis, Montana; W. G. Banks, New Jersey; E. P. Stewart, New York; W. C. Lawrence and W. R. LaDue, Ohio; Alex Lindsay, Northwest; Dana Kepner, Rocky Mountain; A. A. Passolt, Southeastern; F. W. E. Weisse, Southwestern; and L. A. Smith, Wisconsin.

The Southeastern section brought to the meeting 50 of its 124 members, with the result that Paul Weir took back to Atlanta a banner representing the section attendance award. The Old Oaken Bucket went to the California section for the largest membership.

The New Jersey section under the leadership of Arthur Carr of Ridgewood had a big hand in the affairs of the convention. The All-Section dinner was a sell-out, it being impossible to care for some of the late applicants.

Engineering Inspector Examination

New York State

Residents of New York State are eligible for a test for Engineering Inspectors, grade 4, N. Y. City Board of Water Supply. Salary $3,120. Applications should be made prior to July 27, to the N. Y. Civil Service Commission, 96 Duane St., New York.

Readers' Service Department

Activation and Aeration

375. This concise folder No. 1294 describes "Straightline Aerators" for activated sludge treatment; combines these features: 1, rapid circulation in the tanks; 2, exposure of large surfaces, hastened oxidation and bacteriological growth. Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

380. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Aerators for Sewage

381. New 24 page booklet, No. 6571 describes and illustrates the Dorrco Paddle Aerator and also the Turbo-Aerator. Also contains a discussion of the activated sludge method of treatment with much interesting data and illustrations, including a section of "Useful Information." Issued by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. Cast Iron Pipe has beam strength, resistance to crushing stresses and infiltration-proof joints making it highly desirable for flow lines, force mains, submarine lines, outfalls and sewage treatment plants. For specifications write U. S. Pipe and Foundry Company, Burlington, N. J.

Chemical Treatment

385. A handbook on the application of chlorine and iron salts in sewerage treatment. Tech. Publication 177. Wallace & Tiernan Co., Inc., Newark, N. J.

Diesel Engines

386. Write Dept. 118, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago, Ill., for data on how the installation of F-M diesels has lowered taxes and made it possible for many communitines to pay for their improvements out of municipal power plant earnings.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from %Proportioneers, Inc.% 96 Codding St., Providence, R. I.

388. Chemical Feed Machines. Description, principles of operation; data on installation. E. W. Bacharach & Co., Rialto Building, Kansas City, Mo.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

391. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Garbage Incineration

392. Send for full information about the Decarie Suspended Basket-Grate Garbage Incinerator which solves the garbage disposal problem of any city economically and with a minimum of space. Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

393. A special booklet on Municipal Waster Disposal Furnaces will be sent to all interested by The Goder Incinerator Corp., Chicago, Ill.

(Continued on page 53)

Readers' Service Department

(Continued from page 52)

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co.. South Bend, Ind.

Pipe, Concrete

409. Two excellent booklets, 12 and 16 pps., describe manufacture and installation of reinforced concrete pipe for gravity and pressure lines for sewage and storm drainage. Lock Joint Pipe Co., Ampere, N. J.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office, Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago Ill.

Sewers

429. "ARMCO Sewers" is the title of a 48-page booklet describing the structural and other advantages of ARMCO Ingot Iron, Paved Invert and Asbestos-Bonded pipe for storm and sanitary sewers. Design data and large charts will be found helpful by engineers engaged in the design or construction of sewers. Copies will be sent on request by the Armco Culvert Mfrs. Association, Middletown, Ohio, or its associated member companies.

Meter Setting and Testing

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co. Wabash, Ind.

Rainfall Measurement

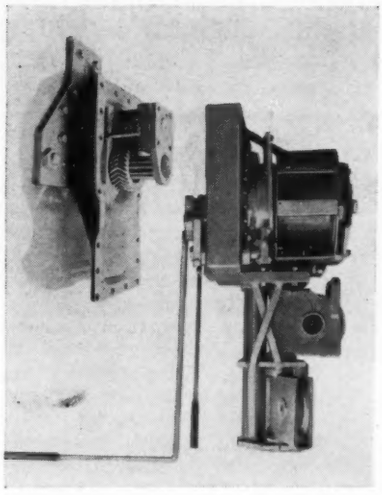
432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Standard recorders for rain, snow and water level. Julien P. Friez & Sons, Baltimore, Md.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Drying and Incineration

439. The five basic steps of: sludge preparation; flash drying; incineration; deodorization; and dust collection are explained in a new 24 page booklet, No. 6781 issued by The Dorr Company, 570 Lexington Ave., New York, N. Y., sales representatives for the C-E Raymond system of sludge drying and incineration.



New Le Tourneau power control unit

C. W. Nichols, Sr., has been elected to the presidency of the Nichols Engineering and Research Corporation, 60 Wall Tower, New York, the products of which include Nichols Herreshoff Sewage Sludge Incinerators, Nichols Decarie Refuse Incinerators, Nichols Herreshoff Multiple Hearth Roasting and Calcining Furnaces, Nichols Freeman Flash Roasters and Nichols Freeman Vortrap Classifiers. Mr. Nichols succeeds H. J. Hartley, who resigned recently.

Proportioneers, Inc., Providence. R. I., have made their FOR bulletin; covering chlorination and ammoniation, available in Spanish and French, as well as in English.

Cover of Patrol Sweeping booklet; see next page.

POSITION WANTED:

Chemist-bacteriologist, recently employed on water supply, desires position in either sewage or water work. Has had experience in both fields. Holds B.S. degree, C.C.N.Y., 1933. Reserve officer, sanitary corps. Will go anywhere. Excellent references, AJK, c/o Public Works, 310 East 45th St., N. Y.

WANTED: SALESMEN AND AGENTS

to sell Traffic Signs, REFLECTOSTRIP, REFLECTOBUTTONS, REFLECTO-LETTERS, and REFLECTOBELTS to Municipalities, Counties, Contractors, and Industries on Commission. Excellent and Profitable Sideline. Write AEROIL—Traffic Equipment Division, Box 599, West New York, N. J.

Readers' Service Department

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 216P East 45th St., N. Y.

Swimming Pools

443. "Pure as the Water You Drink"—a well illustrated booklet of useful data for engineer and contractor, on how to make your swimming pool sanitary, hygienically safe and inviting. Write Graver Tank & Mfg. Co., Inc., 4956 Tod Ave., East Chicago, Ind.

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. "Painting Swimming Pools," an interesting booklet by Dr. A. F. Pistor, covers the subject thoroughly, discussing objectively the relative merits of the different types of coatings recommended for that purpose. Write Inertol Co., 401 Broadway, New York, N. Y.

Taste and Odor Control

448. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a booklet issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 77 pages, tables, illustrations and usable data.

Treatment

450. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

451. "Soft Water for Your Community," tells by means of many interesting pictures and text the advantages of soft water to any community. Ask for a copy from The Permutit Co., Dept. G4, 330 West 42nd St., New York, N. Y.

454. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

461. Ferrisul for Water and Sewage Treatment. Handy booklet describing Ferrisul and telling how it is used. Merrimac Chemical Div., Everett Station, Boston, Mass.

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

HOW TO ORDER

To obtain any of these booklets without obligation, send a post card to the firm whose name and address are given in the description and MENTION PUBLIC WORKS MAGAZINE. Or, if you prefer, send your request to Readers' Service Dept., PUBLIC WORKS, 304 East 45th St., New York, N. Y.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Patrol Sweeper Data:

This book deals with costs; discusses working speeds; provides necessary descriptive information and specifications; covers types of service the patrol sweeper provides; explains and illustrates its adaptability for a wide range of uses; shows how many cities are meeting their street cleaning problems, and provides other information which gives a very good idea of what the sweeper is and does. Brief, to-the-point descriptions, with due regard for the reader's time enable anyone to go through the pages very quickly. The manufacturers will gladly send a copy to any interested person if requested on official stationery. Austin-Western Road Machinery Co., Aurora, Ill.

Double Duty Roads:

This attractive and educational publication describes the road construction activities of the Works Progress Administration in the state of New Jersey. Largely pictorial. Write A. W. Von Struve, Data Section, WPA, Walker-Johnson Bldg., Washington, D. C.

Water Treatment With Activated Carbon:

L. A. Saloman & Bro., 216 Pearl St., N. Y., has issued a 50-page pocket size book on the use of activated carbon in water treatment. It covers the early uses and developments of this material, the use of granular carbon filters, the usual carbon tests for moisture, density, fineness and phenol absorption; the uses of activated carbon, tests for tastes and odors, and useful tables.

Link-Belt General Catalog:

Link-Belt Company, Chicago, has completed its new 1278-page General Catalog No. 800, the largest and most comprehensive catalog it has ever issued, containing list prices, dimensions, weights, and engineering data on power transmission machinery, and on equipment for handling, screening, drying, cooling, preparing materials mechanically. A 44-page pictorial section in the forepart of the book is devoted to giving the recipient a bird's-eye view of the many products that the company makes.

The power transmission equipment and positive drives section comprises 417 pages. There are 376 pages on chains and sprocket wheels; 343 pages on the various types of elevating and conveying equipment; also data on screening, washing, drying machinery; power shovels; car spotters; ice crusher-slingers; automatic coal stokers; and 29 pages of useful engineering tables and data in convenient form for handy reference. *Requests for this book must be made on business letterhead and addressed to Link-Belt Company direct.*

Index to ADVERTISEMENTS